TESTIMONY AT A JOINT HEARING
OF
THE SUBCOMMITTEE ON ENERGY RESEARCH AND PRODUCTION
AND
THE SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT
OF THE
U. S. HOUSE SCIENCE AND TECHNOLOGY COMMITTEE
ON
THE IMPACT OF MERCURY RELEASES AT THE OAK RIDGE COMPLEX

SUMMARY OF ACTIONS AND ACTIVITIES RELATED TO MERCURY RELEASES IN THE OAK RIDGE AREA FROM DOE/UCC-ND OPERATED FACILITIES

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A. REVIEW OF THE USE OF MERCURY AT Y-12

The first buildings of the Y-12 Plant were constructed along East Fork Poplar Creek in 1943 to carry out the first production-scale separation of uranium isotopes for the atomic bomb. Ten years later, in 1953, Y-12 was called upon to undertake the first production-scale separation of the isotopes of lithium for use in hydrogen bombs. Y-12's task at this time was made urgent by the USSR hydrogen bomb test in the fall of that same year. Like the World War II uranium efforts, the lithium process effort required a crash construction program and the overcoming of major technical difficulties. But these efforts also were a success, and the cascades were started up in 1955 after a remarkable 15-month construction period. They were stopped in 1963, having produced this essential strategic material needed for the national defense.

The process that made this challenging program a success is called "COLEX," the name being a contraction of "column-exchange." It is a chemical exchange process in which lithium isotopes are separated as they transfer between two chemical phases. One of these phases is an aqueous solution of lithium hydroxide and the other phase is a solution of lithium in mercury, a lithium amalgam. Many millions of pounds of mercury were essential to the project. Directives signed by President Eisenhower made the mercury available from the National Stockpile. It was this mercury used for the "COLEX" process from 1955 to 1963 that is the source of today's concerns and the subject of these hearings.

Concern for mercury toxicity was very much on the minds of both Atomic Energy Commission (AEC) and Y-12 managers and industrial hygienists as they prepared in 1953 and 1954 for "COLEX" operations. The process was to involve thousands of shift workers, and programs were instituted before the cascades went into operation to cope with the recognized hazards of breathing mercury vapor. The building floors were modified so that the floor drains emptied into special mercury collection tanks in the basement. Here mercury could be separated from mop water and other solutions before passing to other water-collecting sumps inside and then outside the buildings before going to the creek.

These precautions were taken because it was recognized that Y-12 was pioneering an entirely new process using pumps and other equipment that had never before been utilized for this particular application. The engineers anticipated frequent maintenance and troubles during start-up of these new processes involving pumping huge quantities of mercury under pressure. The first year of production, 1955, was indeed a troublesome one. Many problems developed with the equipment. Pumps and valves needed to be serviced often. The process equipment was full of mercury, and spillage of small quantities in maintenance operations was expected and encountered. It was accommodated by special drip pans, collection containers, and administrative procedures. The mercury concentration in the workplace air was monitored frequently. (In 1956, 280,000 air samples were measured.) In the 1955 cascade start-up, higher concentrations of mercury in workplace air were encountered than acceptable. Toward the end of 1955, for instance, many of the readings were in excess of the American Conference of Government Industrial Hygiene (ACGIH) recommended value of 0.1 mg/m^3. A urinalysis program had been started in 1953 and was expanded to provide a check on the worker mercury exposures. During the time that high concentrations of mercury in air were encountered in 1955, the urinalysis data also showed higher readings, although the averages for all workers never exceeded the recommended urinalysis mercury limit of 0.3 mg/L. Still, some individual workers had readings that did exceed the 0.3 mg/L level. When urinary mercury values for an individual remained at a high level for several specimens, the personnel (approximately 70 people) were assigned to other work areas, then returned when their urinalysis mercury levels dropped to the normal range.

In addition to the air sampling and urinalysis programs, there was a routine medical surveillance program with clinical examinations for all mercury workers every six months. Persons with a history of albuminuria, kidney problems, or hypertension were screened out and not allowed to work with mercury.

Toward the middle of 1955, AEC and Y-12 management recognized the urgency of reducing high mercury vapor levels, and a crash program was undertaken to bring the levels down. The program involved technical studies of substances that could reduce vapor pressure or that could dissolve tiny mercury droplets. Engineering changes to reduce process losses were involved, including a renovation of the buildings' ventilation systems with the installation of huge fans in the end walls to provide more fresh air to the buildings. Other changes included major new housekeeping programs and the installation of a special house-vacuum system for mercury pickup. The net effect of these and other administrative efforts is documented by the historical record of air concentrations, which shows that the air levels were dramatically reduced and under control by March 1956 and stayed under control during the next seven years of operation.

In 1974 a consultant from the National Institute for Occupational Safety and Health (NIOSH), Dr. Z. Bell, reviewed the Y-12 data on mercury worker exposure. He selected 50 of the original workers who had received high exposures (based on urinalysis) and asked the Y-12 medical staff to examine them according to a protocol that he furnished. None of the 23 employees still on the payroll showed any symptoms of mercury poisoning.

More recently, in 1983, Oak Ridge Associated Universities (ORAU) conducted a preliminary epidemiological study of the mortality of the Y-12 mercury worker population by comparing this group (1477) to the other Y-12 workers (4920), then comparing both groups to the U.S. population as a whole. The purpose was to determine whether there is any evidence to suggest that the death rates due to cancer or any other causes are higher for the employees who worked in the Y-12 mercury exposure areas than for other Y-12 employees. No such evidence was found. Death rates for mercury workers as a group were 93% of the rates for the U.S. population group to which they were compared, while the death rates for the other Y-12 nonmercury workers were 90% of the rates for the U.S. population. The statistical confidence intervals for each overlapped considerably, and no significant difference was found. Similarly, no difference was found between the Y-12 mercury workers and the other Y-12 workers in the death rates due to cancers, diseases of the central nervous system organs, respiratory diseases, or chronic nephritis.

Losses of mercury from the "COLEX" process at Y-12 between 1955 and 1963 can be classified as loss to air, water, and land. Losses to water (i.e., East Fork Poplar Creek) are for the most part traceable to a process waste stream. The operation responsible for generating this waste was a mercury purification step in the operation of the "COLEX" process but was successfully modified in 1958 and the modification significantly reduced mercury losses. Mercury was discharged to the creek from this source in the form of a dilute, neutralized acid waste. The appearance of this waste stream carrying mercury to the creek was that of an almost clear solution. The mercury was present as a soluble or as a very finely divided suspension of mercuric oxide.

In 1963 and 1964 New Hope Pond was built to permit mixing and thus to even out the varying pH in the effluent from the Y-12 Plant. An unanticipated secondary benefit was the retention of substantial quantities of mercury-containing sediment. The mercury in these sediments came from secondary sources of mercury, not from the "COLEX" process waste stream which was finally stopped in 1963. The secondary sources are contamination of building drain systems, sewers, and lines connecting the process buildings to the creek headwaters or ditch. These lines contain mercury in some of the joints and contaminated sludges, etc., which continue to serve as a source of small amounts of mercury.

During "COLEX" operations, concern was focused on quantities of mercury lost to the creek, with concentrations of mercury measured and reported quarterly starting in 1954. Stream flows and thus total quantities of mercury were measured and reported beginning in the last quarter of 1955.

The possibility that mercury releases might constitute a much more serious problem than posed by what was believed to be relatively nontoxic, inorganic mercury was first publicized in the news media in

March 1970 by a Canadian scientist, Norwald Fimreite, who had linked high concentrations of mercury in fish to biological conversion of inorganic mercury to methylmercury.

Significant incidents involving mercury contamination of people were those at Minamata (1953) and Niigata (1965) in Japan. Prior to the 1950s, mercury contamination often was related to the use of medicinals and usually cosmetics containing mercury compounds. However, I read recently that in 1700 a citizen of Fiwale, Italy, sought an injunction against a factory manufacturing mercuric chloride because of its lethal fumes.

Other incidents of mercury poisoning occurred between 1956 and 1972 involving thousands of people in Iraq, Pakistan, Guatemala, Yugoslavia, and Sweden. Often, these incidents were related to the ingestion of grain seeds treated with mercurial fungicides. In 1967, the Swedish Medical Board banned the sale of fish containing high concentrations of methylmercury from about 40 lakes and rivers.

In the early 1970s, restrictions on fishing and sale of fish were imposed in many areas of the USA and Canada, and both countries began to control releases of mercury-containing wastes into lakes and streams (Goldwater, 1971). By September 1970, an ORNL study showed 18 states where some restrictions were in effect. Prior to 1967, no one realized that inorganic mercury could be biologically converted to organic methylmercury.

It is important to realize that environmental and public health standards were not developed until the 1970s as shown in the Table 1. There were no metallic mercury standards prior to 1943. In the early 1970s (see Table 2), the value for mercury in air was decreased by a factor of two. No standard exists for urinary excretion. Y-12 has used the administrative guideline of 0.3 mg/L as a plant action value.

The attention that focused on the methylmercury problem in 1970 was responsible for initiating widespread studies of mercury concentrations in fish as well as sediments, river water, etc., throughout the United States. The first Y-12 study of mercury concentrations in East Fork Poplar Creek fish was done in 1970 and

Table 1. Environmental and public health standards and criteria for mercury

	Standard in 1950	Current standards and date effected		
		Units	(ppm)	Date
Air - Workplace (ACGIH)	0.1 mg/m^3 (1946)	mg/m^3	0.05 mg/m^3	1971
Water - Drinking (EPA)	None	mg/L	0.002	1975
Water - Stream (EPA)	None	mg/L	0.00005	1976
Effluent discharges (TN)	None	mg/L	0.05	1977
Fish flesh (FDA)[a]	None	µg/g	1.0	1979
Solid waste burial, EP Test (EPA)	None	mg/L	0.2	1980
Sediment	None	None	None	

[a]Not a formal regulation. An FDA administrative action level.

Table 2. Chronology of mercury standards

Year	Organization	Guideline/standard Air (mg/m^3)	Guideline/standard Urine (mg/L)
1943	American National Standards Institute (ANSI)	0.1	
1946	American Conference of Government Industrial Hygiene (ACGIH)	0.1	
1952	Y-12 Plant	0.1	0.3
1957	University of Rochester recommendations	0.1	0.3
1971	American National Standards Institute (ANSI)	0.1	
1971	American Conference of Government Industrial Hygiene (ACGIH)	0.05	
1972	American National Standards Institute (ANSI)	0.05	
1973	National Institute for Occupational Health (NIOSH)	0.05	
1973	Y-12 Plant	0.05	0.3

showed the range of 0.32 ppm to a high of 1.30 ppm (memorandum from Sanders to McLendon, dated August 1970, Appendix 4). An ORNL study in that same year surveyed fish from all over the United States and showed that mercury concentrations in fish from Pickwick Lake range to 2.1 ppm and in fish from the Holston River range to 4.4 ppm.

Current Assessment

The current situation on discharges to East Fork Poplar Creek is monitored by taking samples of the outflow of New Hope Pond. "Grab" samples are taken every Monday morning, and a "composite" sample is taken on a flow-proportional basis that represents the best estimate of the mercury discharged. Over the 24-month period from 1981 through 1982, the overall average concentration was 1.3 ppb versus the interim drinking water standard of 2.0 ppb set by the Environmental Protection Agency (EPA). in 1975. The maximum value was 7.0 ppb. Taking flows into account, this means that over these two years 64 lb of mercury was released, an average of 1.4 oz/day or 39 g/day. Almost all is suspended or insoluble mercury. Material balance studies have been done in the last year to find out where this mercury originates. Each pipe feeding water into the creek headwaters or the ditch that flows into New Hope Pond was sampled and its flow measured. The effluent pipes from Buildings 9204-4 and 9201-5 contributed 47%, the pipes from 9201-4 and 81-10 contributed 44%, and the pipes from 9201-2 contributed 8% of the mercury entering New Hope Pond during the two days studied in December 1982. Of the total amount entering New Hope Pond on those days, 100 g were retained in the pond and 42 g were released to the creek.

In the last few months there has been an active program to identify the sources and form of mercury contamination and to clean up the sources: the Building 81-10 salvage area; the sumps in Buildings 9201-4, 9201-5, and 9201-2; drain lines; and storm sewers. This cleanup activity has stirred up sediments in pipes and lines, which has resulted in creek concentrations that are temporarily higher than the levels of 1981-1982. It is expected that when these operations are complete the mercury levels in the creek will drop below the 1981-1982 levels.

In addition, Y-12 will undertake subsurface studies to determine whether mercury accumulations can be located below sites of spills or operational facilities. A further objective is to find out whether there is any significant contamination of groundwater from those past losses. Further studies under way include a study of the Chestnut Ridge sediment disposal site to see whether it is contaminating groundwater. In addition, a variety of specific efforts are under way in support of work being done by others: the University of Rochester, Battelle-Columbus, Department of Energy (DOE)-ORO, etc.

B. ESTIMATED HEALTH RISK TO PEOPLE AS A RESULT OF CONSUMING AQUATIC ORGANISMS FROM EAST FORK POPLAR CREEK

The ultimate question related to a mercury-contaminated environment is the risk to human health. We will attempt to estimate the degree of risk associated with consuming aquatic organisms from the East Fork Poplar Creek. To do this, one must estimate the level that mercury would reach in the tissues of man from consuming these organisms. It should be pointed out that mercury is ubiquitous. Everyone's tissues contain mercury and we are constantly taking mercury into our bodies through the daily consumption of food and liquids. There is information, although scarce, on the "normal" intake of mercury by people. Several studies suggest intakes of about 3 to 4 μg per day (see Gerstner and Huff, 1977). The U.S. Food and Drug Administration systematically samples and surveys market products. In 1973, the FDA survey indicated an average dietary intake of 2.89 μg of mercury per day. Most of this was from fish (Food Chemical News: August 4, 1975). Mercury concentrations in some fish and shellfish sometimes exceed 0.5 μg/g tissue.

The level of mercury that accumulates in human tissues depends on many factors, including the amount taken in and the biological half-life in man. The biological half-life is the time required for the mercury concentration in man to drop by one-half, providing no additional mercury is taken into the body. The biological half-life reported for methylmercury in man is 76±3 days (World Health Organization, 1976). Other data suggest an average biological half-life value of about 70 days, with a larger amount of variability from person to person. Thus, following a single intake, methylmercury would be absorbed from the gut and distributed to various body tissues. Half of the mercury would be lost from the body in about 70 days and only about 1.5% would remain after 420 days.

However, for repeated intakes, an equilibrium level is reached between intake to and loss from the body. For mercury, the equilibrium body level is about 100 times the daily intake. For small daily intakes the equilibrium level will be small, whereas larger equilibrium levels will result from larger daily intakes. In either case, the equilibrium level in the body, sometimes called the body burden, will be about 100 times the daily intake.

Methylmercury is the chemical form of mercury that is most toxic to man. The source of methylmercury in the environment may be inorganic mercury that has been methylated in water by bacteria. Usually from 80 to 95% of the total mercury in aquatic organisms is reported to be methylmercury. Fish incorporate the methylmercury into their tissues from the water. The methylmercury is relatively nontoxic to the fish because of their simpler nervous system as compared with humans. The biological half-life in fish is usually longer than that in man. For the purpose of this evaluation, we assumed that all of the mercury in fish and aquatic organisms from East Fork Poplar Creek is methylmercury. When fish or aquatic organisms are eaten by man, practically all of the methylmercury from these foods is absorbed from the gastrointestinal tract.

To estimate the concentration of mercury that will be reached in the tissues of humans, the amount of these organisms that is consumed and the frequency with which these organisms are consumed must be known. The consumption rate of fish and other aquatic organisms in the United States varies greatly. The average per capita consumption of fish in the United States was estimated to be in excess of 20 g/day (0.7 oz/day) or about 16 lb/year; however, 1% of the population may consume 77 g/day (2.7 oz/day) (Stroud, 1977).

From Swedish studies of Japanese individuals contaminated in the episode of Niigata and from biochemical studies in Finland and Sweden (Federal Register, 1979), it was concluded that the lowest blood level of mercury that would bring about signs and symptoms of methylmercury poisoning was 200 parts per billion (ppb) (0.2 ppm). The body burden would be approximately 30,000 μg (30 mg) of mercury. To obtain this equilibrium level requires a minimum daily intake of approximately 300 μg of methylmercury. In setting standards for large populations it is usual to apply a safety factor. The safety factor usually is 10.

Thus, the "allowable" level would be 20 ppb of methylmercury in blood or a body burden of 3000 μg (3 mg) of mercury. The corresponding intake required to reach this blood (or body) equilibrium level would be 30 μg of mercury every day.

The highest mean concentrations of mercury in aquatic organisms from the East Fork Poplar Creek were collected between New Hope Pond and the Bear Creek Road bridge at the entrance to the Y-12 Plant area. The mean concentration of total mercury from seven bluegill collected in this area was 2.13 μg/g fresh weight (Van Winkle et al., 1982). An individual would have to consume 14.1 g (0.5 oz) of these fish every day from this location before his blood mercury level would reach the "allowable" level of 20 ppb. It would take about one year for the body burden to essentially reach equilibrium. During that time, 11 lbs would need to be ingested by that individual.

The mean concentration of mercury in the muscle tissue of frog legs and crayfish tails collected near this same station was 0.60 and 2.50 μg/g fresh weight, respectively (Blaylock et al., 1983). Thus, an individual consuming either 50 g/day (1.8 oz/day) of frog legs or 12 g/day (0.4 oz/day) of crayfish tails for about one year would accumulate the "allowable" body burden of mercury.

The mercury concentrations in fish tend to decrease with distance from Y-12. Therefore, larger quantities of fish would need to be ingested before the "allowable" body burden of mercury was reached. If, for example, the average concentration in fish was 0.2 μg Hg/g, an individual would have to consume 107 lb of these fish in one year to reach "allowable" body burden.

A sample of only one turtle was collected on the East Fork Poplar Creek some distance below where the other samples were collected. The concentration of mercury in the turtle was 0.46 μg/g fresh weight. Thus, an individual would have to consume 65.2 g/day (2.3 oz/day) of this turtle for about one year to reach the "allowable" body burden of mercury.

It should be remembered that the allowable level of 20 ppb of mercury in the blood has a safety factor of 10; therefore, a much larger quantity of the organisms could be consumed daily before reaching the "allowable" level in the body, a level at which the first symptoms of methylmercury poisoning may appear.

Another point that should be made is the size of the populations of aquatic organisms that inhabit the East Fork Poplar Creek. Fish populations in this stream have not been estimated using quantitative methods, but the populations do not appear to be very large. It is doubtful that a large number of organisms could be harvested on a regular basis from the East Fork Poplar Creek, especially the quantity required to provide food on a daily basis.

In summary, we feel that the release and subsequent widespread distribution of mercury in the Poplar Creek drainage basin and the Clinch River do not constitute an acute risk to human health or the environment. We cannot arrive at the same conclusion regarding the longer-term or chronic threat that the release might pose without more information on the locations and amounts of mercury in the aforementioned aquatic systems and on the extent of accumulation of mercury in human food chain organisms over extended periods of time.

C. ENVIRONMENTAL PROTECTION

The management of hazardous materials, their use, storage, surveillance, and disposal in a manner that ensures minimum impact on the environment is a line responsibility in each of the three Oak Ridge installations operated by the Nuclear Division. Each installation has in place an organizational unit to develop appropriate procedures and surveillance to ensure that the objective of the minimal environmental impact is achieved. At the Oak Ridge National Laboratory (ORNL) this unit is the Environmental Management Department of the Industrial Safety and Applied Health Physics Division. At the Oak Ridge Gaseous Diffusion Plant (ORGDP) and the Oak Ridge Y-12 Plant (Y-12), the environmental management departments are units of the Health, Safety, and Environmental Affairs divisions of the respective plant organizations.

At the Nuclear Division level, an office of Health, Safety, and Environmental Affairs, under the general direction of the ORNL Associate Director for Biomedical and Environmental Sciences, has the responsibility to initiate and/or coordinate installation environmental protection and monitoring programs consistent with the requirements of the Department of Energy (DOE) and to compile and issue annual reports of the monitoring programs. The organization charts in Appendix 1 provide more specific details.

The ORNL Environmental Sciences Division, a mission-oriented research and development unit of ORNL, has as its principal objectives (1) to conduct research leading to the development of pertinent environmental information about existing and emerging energy technologies, and (2) to utilize this knowledge in a way that is consistent with acceptable environmental protection concepts to prevent and solve problems arising during the development and implementation of these technologies. Within and without ORNL, the division's research provides and substantiates the environmental data, as well as the understanding of the environmental mechanisms, that are utilized by other organizations that have responsibility for evaluating or assessing health and safety impacts. The division's focus is on environmental matters, not human health or the related health science disciplines.

One example of this emphasis is the role the division has played, and continues to play, in studying mercury contamination on the Department of Energy (DOE) Oak Ridge Reservation and environs. While the Environmental Sciences Division has no direct authority to initiate environmental surveillance activities, it has been continuously responsive to requests to provide technical expertise on the mercury issue. As our testimony will indicate, the Environmental Sciences Division has recommended in reports and memoranda within the Nuclear Division/DOE organization that additional studies and monitoring are necessary to document the nature and extent of the mercury contamination problem in a scientifically credible and professionally responsible manner. Through our research on the DOE Oak Ridge Reservation, on the Holston River-Cherokee Reservoir in Virginia and Tennessee (Hildebrand et al., 1980a), and at the world's largest mercury mine in Almadén, Spain (Hildebrand et al., 1980b), the Environmental Sciences Division has developed an outstanding research group of geochemists, aquatic ecologists, and terrestrial ecologists publishing on various aspects of mercury contamination in the environment.

Mercury Studies Conducted by the Environmental Sciences Division at Oak Ridge National Laboratory

The purpose of the following discussion is to document that the Environmental Sciences Division at Oak Ridge National Laboratory has been involved in mercury studies for many years. Staff members of the Environmental Sciences Division were involved in mercury studies as early as 1970 (ORNL, 1971). The division has cooperated and jointly conducted research on mercury in the environment with federal agencies and authorities, state governments, and foreign countries. A large number of reports and open literature publications have resulted from these studies. A selected few will be used to document the division's involvement in mercury studies.

In the early studies funded under a research grant from the National Science Foundation, the investigators utilized the division's expertise in the cycling of radionuclides in the environment to conduct tracer studies with ^{203}Hg. The purpose of these investigations was to determine the cycling and concentration of mercury in the environment. For example, studies were conducted on: (1) the cycling of mercury in an old-field ecosystem to determine the uptake, concentration, and movement of mercury in plants and soil (Matti et al., 1975); (2) the accumulation and transfer of methylmercury in aquatic food chains (Blaylock et al., 1973; Huckabee et al., 1975, 1979); (3) the movement and distribution of inorganic and methylmercury in small streams (Huckabee and Blaylock, 1973); and (4) model development and validation of the behavior of methylmercury in a freshwater pond (Huckabee and Goldstein, 1975).

Early studies included measurement of mercury in the local east Tennessee environment. The use of mosses as indicators of airborne mercury pollution (Huckabee, 1973; Huckabee and Janzen, 1975) and the establishment of background levels of methylmercury in fish from the Great Smoky Mountains National Park (Huckabee et al., 1974) were two of the earlier studies.

As a result of our demonstrated expertise in environmental mercury research, investigators from the Environmental Sciences Division became involved with the state of Virginia, the state of Tennessee, and the Tennessee Valley Authority in establishing the mercury inputs to the Holston River-Cherokee Reservoir system from the chloralkali plant located in Saltville, Virginia (Hildebrand et al., 1980a). Several publications resulted from this study and include: "Behavior and Transport of Mercury in a River-Reservoir System Downstream of an Inactive Chloride Plant" (Turner and Lindberg, 1978), "Distribution and Bioaccumulation of Mercury in Biotic and Abiotic Compartments of a Contaminated River-Reservoir System" (Hildebrand et al., 1976), and "Mercury Accumulation in Fish and Invertebrates of the North Fork Holston River, Virginia and Tennessee" (Hildebrand et al., 1980c).

More recent studies conducted by the Environmental Sciences Division have focused on atmospheric mercury releases to the environment. These studies include atmospheric releases from contaminated soils (Lindberg et al., 1979), from chlorine production solid waste deposits (Lindberg and Turner, 1977), and from power plants (Lindberg, 1980).

Mercury studies by members of the Environmental Sciences Division were not limited to the United States. The Environmental Sciences Division was involved through the U.S. Department of State in an ecological study of the distribution of mercury in the environment in the vicinity of mercury mines in Almadén, Spain (Hildebrand et al., 1980b). The Almadén mining operations have generated the oldest and possibly the most extensive case of mercury effluents in the world. The study, which was initiated in 1974 and completed in 1977, was conducted in both terrestrial and aquatic systems with the objective of defining the range of mercury concentrations in ecosystem compartments and determining the distribution of mercury in these compartments with distance from the mining area. The research was funded by the National Science Foundation Office of International Programs, in accordance with agreements for scientific collaboration between the United States and Spain. The study was a joint effort with Spanish investigators at the mining operations, the Environmental Protection Agency (EPA), and the Environmental Sciences Division at ORNL. Staff members from the Environmental Sciences Division spent several months in Almadén while directing, conducting, and coordinating the research. Mercury analyses were conducted in Spain and at ORNL. Expertise from the Analytical Chemistry Division at ORNL was also provided to help establish procedures for mercury analyses in Spain. Several publications (Hildebrand et al., 1980b; and Huckabee et al., 1983; Lindberg et al., 1979) which resulted from this study enhanced the reputation of the Environmental Sciences Division as a recognized center of expertise for mercury pollution research.

Additional studies on mercury and other trace contaminants that reinforce the Environmental Sciences Division's activities in pollution studies have not been included in this brief summary. Our aim is to establish for the record that the Environmental Sciences Division has been involved in mercury research, especially that dealing with its behavior in freshwater environments, including uptake and accumulation by fish and other aquatic organisms, for many years.

D. ENVIRONMENTAL SURVEILLANCE, MONITORING, AND REPORTING

Monitoring of radioactive and chemical effluents, both gaseous and liquid, is conducted at each of the Oak Ridge installations. Starting in 1971, data from ORGDP, ORNL, and Y-12 have been compiled in an annual Environmental Monitoring Report for the Oak Ridge facilities. The measured effluents are compared to applicable standards and are intended to inform the reader of the effectiveness of the pollution control program at each of the Oak Ridge facilities. The report is distributed to EPA, Tennessee State Health Department, Oak Ridge Department of Public Health, and local news media.

EARLY ACTIVITIES (Y-12, ORGDP)

Mercury concentrations in the Y-12 effluents to the East Fork of Poplar Creek were measured at the Y-12 Plant starting in 1954, and quarterly averages have been recorded since that time. It is to be noted (Fig. 1) that the mercury concentrations were significantly higher during the period 1955-1959 than at any other time and that the majority of the mercury was discharged to East Fork Poplar Creek during the period mid-1956 to 1959. Our current estimate of the discharge over the years is now about one-half of what we estimated it to be in 1977 (239,000 vs 470,000 lb).

In 1970, Merwyn Sanders, the Y-12 Environmental Coordinator, initiated a survey to determine the mercury content in fish, water, and sediment samples from various parts of the Oak Ridge area. These results were reported to J. D. McLendon in an internal memorandum dated August 6, 1970 (see Appendix 4).

Following is a summarization of the findings of this survey:

- Twenty-one fish were caught from New Hope Pond, East Fork Poplar Creek, and Bear Creek.

- Ten of the fish exceeded the U.S. Public Health Service 1970 limit of 0.5 ppm.

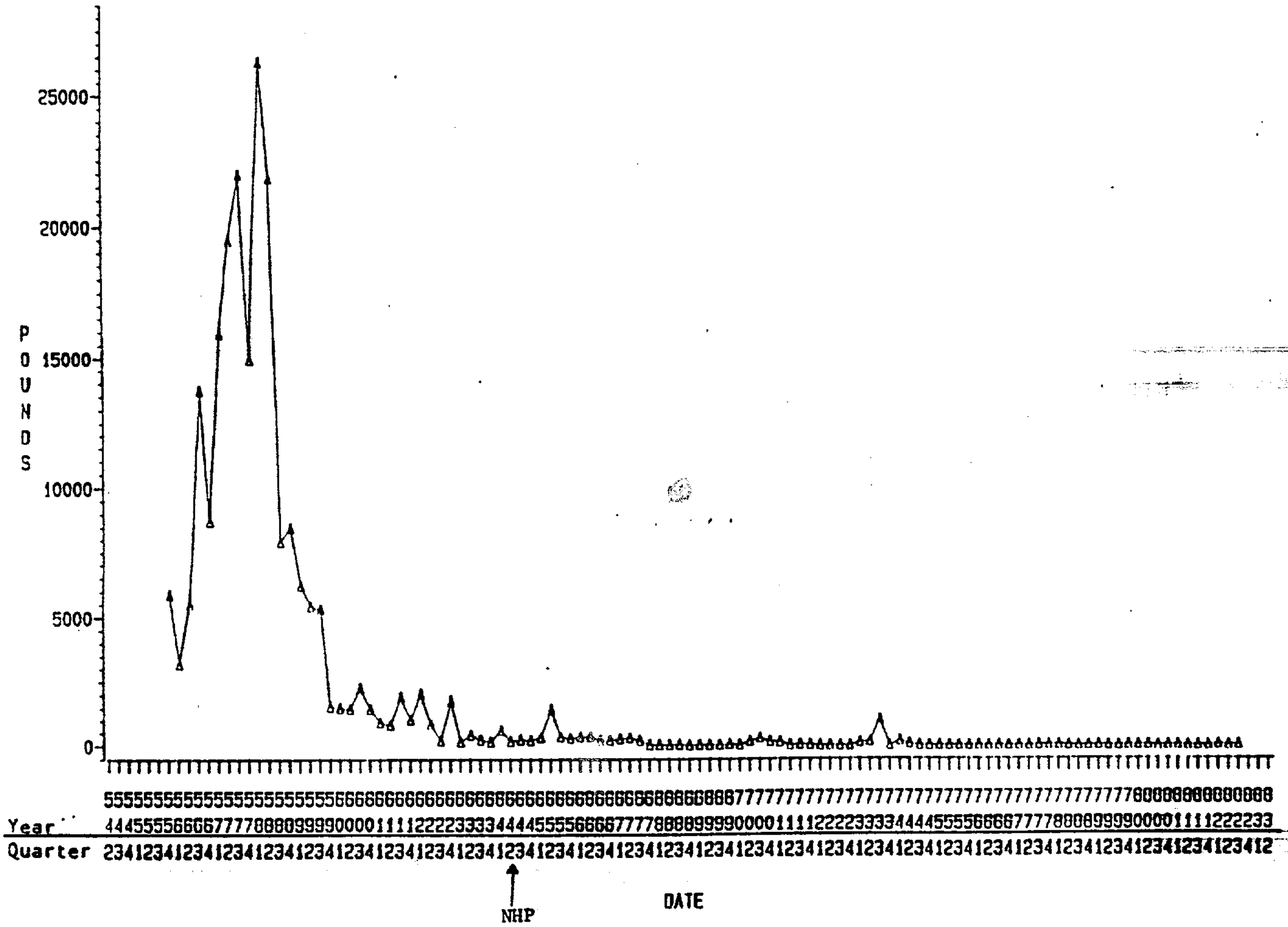

Fig. 1. Mercury losses to East Fork Poplar Creek, fourth quarter 1955 through third quarter 1982.

- Five fish were purchased at an Oak Ridge market and two from the Y-12 cafeteria, levels ranged from 0.03 to 0.67 ppm, average was 0.203 ppm.

- The average concentration of the twenty-one fish was 0.48 ppm and the highest was 1.3 ppm.

- Twelve water samples were taken in New Hope Pond, East Fork Poplar Creek, Bear Creek, and Melton Hill Lake. A maximum concentration of 0.0005 ppm was reported.

- Ten mud samples were taken in New Hope Pond, East Fork Poplar Creek, Bear Creek, and Melton Hill. A maximum concentration of 63 ppm was reported.

Data from the measurement of mercury in the effluent from New Hope Pond have been included in the annual Environmental Monitoring Report of the Oak Ridge facilities since the report was first issued in 1971. Table 3 provides a compilation of the data taken from these reports for the years 1971-1982.

A sediment sampling program was initiated by ORGDP in 1975 to determine the concentrations of various metals in Poplar Creek. Samples are collected twice annually and analyzed for various metals, one of which is mercury. These data have been included in the annual Environmental Monitoring Report since that time (see Table 4).

AQUATIC MONITORING PROGRAM FOR ENVIRONMENTAL ASSESSMENT (Y-12, ORNL, CARL, AND ORGDP FACILITIES) 1974-1975

In the early part of 1974, the Atomic Energy Commission (AEC) decided that information should be compiled on the Oak Ridge facilities [Y-12, ORNL, Comparative Animal Research Laboratory (CARL), and Oak Ridge Gaseous Diffusion Plant (ORGDP)] for an environmental assessment to provide a basis for judging whether an environmental impact statement should be prepared for these facilities. The Environmental Sciences Division was requested to provide information for this document and to conduct a short-term aquatic surveillance program (ERDA, 1975, Vol. VI) to supplement the available data that would be used to describe the aquatic systems identified as possible

Table 3. Water quality data – East Fork Poplar Creek. Mercury concentrations in New Hope Pond discharges (Y-12) reported in annual environmental monitoring reports[a]

	Concentration (mg/L)[b]		
Year	Maximum	Minimum	Average
1971	0.007	0.0005	0.003
1972	0.0009	<0.0005	<0.0006
1973	0.001	0.0003	0.0005
1974	<0.0005	<0.0005	<0.0005
1975	0.0009	<0.0005	<0.0006
1976	0.0008	<0.0005	<0.0005
1977	0.003	<0.0005	<0.002
1978	0.002	<0.0005	<0.001
1979	0.004	<0.001	<0.002
1980	0.003	<0.001	<0.002
1981	0.002	<0.001	<0.002
1982	0.007	<0.001	<0.002

[a]Environmental monitoring reports, (United States Atomic Energy Commission 1971-1973, United States Energy Research and Development Administration 1974-1976, United States Department of Energy 1977-1982) Oak Ridge Facilities.

[b]Monthly composite samples are analyzed. The annual values are based on an average of the results of the monthly analyses.

Table 4. Sediment data (dry weight basis)[a]
Mercury (µg/g)

Location[b]	1976	1977	1978	1979	1980	1981	1982
CS-1	<0.5	0.3	<0.2	<0.2	4	1	3
PS-2	2	26.6	7	35	4	6	
PS-3	11	11.9					
PS-4	2	12.2					
PS-5	8	1.4	2	<0.3	5	4	
PS-6	8	39	8	11	12	10	10
PS-7	68	1.8					
PS-8	1	1.6					
PS-9	10	11	2	3	5	3	
PS-10	<3	2.7	17	3	19	10	19
PS-11	<5	4.6					
PS-12	3	<2.9	6	<9	6	6	
PS-13	50	3.3					
PS-14	2	153.6					
PS-15	2	4.0	21	6	4	10	
PS-16	3	11.3					
PS-17	1	9.6	<2	<13	11	3	9
PS-18		20.4	5	4	10	6	9
PS-19		41.9	14	21	14	9	8
PS-21			6	<1	4	2	51
PS-22			3	7	13	96	
CS-20		0.4	<0.2	<0.2	1	3	3

[a]Average of two samples collected annually.

[b]Figure 9 - 1977 Environmental Monitoring Report.

areas of impact. It was realized that the data from this short-term survey would not be sufficient to assess the impact of the Oak Ridge facilities on aquatic biota (ERDA, 1975, Vol. VI), but they would aid in developing a more comprehensive monitoring program for impact analyses.

The survey was initiated in August of 1974 and continued through March of 1975. Locations of the sampling stations are given in ERDA (1975, Vol VI). Data from the survey were used along with routine monitoring data for the facilities and other information to publish a "Preliminary Draft Environmental Analysis, Oak Ridge Operations" (ERDA, 1975). Sediment analyses for mercury from the East Fork Poplar Creek and tissue analyses of fish from Poplar Creek were included in the report. It was stated on page 73 of Volume VII (ERDA, 1975) of the Preliminary Draft Environmental Analysis that preliminary analyses of tissue from fish collected in Poplar Creek showed mercury levels as high as 0.5 μg/g in bluegill and 2.0 μg/g in carp. These levels equaled or exceeded the then action level of 0.5 μg/g for commercial fish, as set by the U.S. Food and Drug Administration, which was subsequently changed to the present action level of 1.0 μg/g. It was also stated on page 73 of Volume VII (ERDA, 1975) that excessive mercury levels would preclude the use of Poplar Creek for fishing, both recreational and commercial.

The "Preliminary Draft Environmental Analysis, Oak Ridge Operations" (ERDA, 1975) was submitted to ERDA/ORO, along with a proposed sampling program (and a summary of the estimated cost), indicating that the monitoring program was needed to upgrade the analysis to the status of a draft environmental impact statement (Appendix 2, letter from R. F. Hibbs to R. J. Hart, December 1975). Circumstances evolving from this draft report and the proposed monitoring program played a role in the request that culminated in the Report on Mercury Contamination in Poplar Creek and the Clinch River (Elwood, 1977) (Appendix 3).

1977 UCC-ND MONITORING ACTIVITIES

The annual monitoring reports for the DOE-Oak Ridge Facilities were formal documents which were given state and local distribution.

The following is a quote from the 1977 Environmental Monitoring Report (Y/UB-8) with regard to the mercury in fish study which was conducted in 1976 and 1977:

> "As a result of higher than background mercury concentrations in creek sediments and known use of large quantities of mercury at the Y-12 Plant until 1963, a fish study in Poplar Creek and the Clinch River was undertaken in 1976 and 1977 to determine the significance of these findings. Both migratory and nonmigratory fish, including edible and rough species, were studied.
>
> During 1976 and 1977, 649 fish were analyzed. Sixty-two edible fish from this group contained mercury concentrations exceeding the proposed Food and Drug Administration (FDA) action level of 0.5 μg/g. Representative of average concentrations in fish taken from Poplar Creek near ORGDP are largemouth bass 0.72 μg/g, bluegill 0.42 μg/g, and crappie 0.23 μg/g. Fish taken from the Clinch River near Poplar Creek showed average concentrations in largemouth bass of 0.38 μg/g, bluegill 0.15 μg/g, and crappie 0.14 μg/g.
>
> While these mercury concentrations are higher than background measurements made from Melton Hill Reservoir fish (bass <0.02, bluegill <0.04, crappie 0.03), they do not constitute a toxicity hazard. The FDA proposed action level (proposed in December 1974) does not apply to individual fish, rather to averages, in order to control total mercury consumption. The action level is based on a consumption rate three times the national average plus an additional safety factor of ten as well. An overall safety factor of 30 results. Thus, while some of the fish taken in the vicinity of ORGDP exceeded the proposed action level, an extraordinarily high and protracted consumption rate of these fish would be needed in order to reach levels of concern."

The analysis of mercury in fish collected from the Clinch River was made a part of the ORNL monitoring program in 1978 and data from these measurements have been included in the Environmental Monitoring Reports beginning in 1978.

1977 ENVIRONMENTAL SCIENCES DIVISION REPORT ON MERCURY CONTAMINATION IN POPLAR CREEK AND THE CLINCH RIVER

In early 1976 (April or May), the Environmental Sciences Division (ESD) was requested to assist in the design and implementation of a study to determine the mercury concentration in fish in the vicinity of the Oak Ridge Gaseous Diffusion Plant (ORGDP). The request for ESD participation in the study and in preparing a report on the results was made at a meeting at the Y-12 Plant attended by staff from DOE/ORO (J. F. Wing, W. Hibbitts), UCC-ND (R. G. Jordan, H. H. Abee), ORGDP (M. E. Mitchell), Y-12 (M. Sanders), and ORNL/ESD (J. W. Elwood, L. D. Eyman).

Mitchell from the Environmental Management Department at ORGDP explained why they wanted the study done. The ORGDP staff was concerned that the elevated mercury level in the lower portion of Poplar Creek was coming from ORGDP. They wanted to know (1) if fish in the vicinity of ORGDP were contaminated with mercury, (2) if the contamination had spread into the Clinch River downstream of ORGDP, and (3) the source of the contamination (i.e., whether the mercury in Poplar Creek was from upstream sources, from ORGDP discharges, or both). Elwood and Eyman recommended sampling fish in the Clinch River, in Poplar Creek upstream and downstream of ORGDP, and in East Fork Poplar Creek. Sampling in East Fork Poplar Creek, which enters Poplar Creek just upstream of ORGDP, was recommended for two reasons. First, we were aware of local monitoring data showing elevated mercury levels in sediments (memorandum from Sanders to McLendon, August 1970, Appendix 4; Reece, 1974) and fish (memorandum from Sanders to McLendon, August 1970, Appendix 4) from this stream. Second, we were aware of mercury losses that had occurred at Y-12. Thus, in designing the fish sampling, our staff members considered the possibility that the mercury in sediments in the lower portion of Poplar Creek was coming from East Fork Poplar Creek. Subsequently, it was decided that the proposed sampling for this study would be limited solely to Poplar Creek and the Clinch River.

The 1976-1977 study did show significant mercury contamination of fish but did not identify the source(s) of mercury in Poplar Creek (Elwood, 1977). Analysis of unpublished data on mercury in East Fork Poplar Creek, which is contained in Elwood (1977), did suggest East Fork Poplar Creek as a likely source of mercury in Poplar Creek and the Clinch River. This suggestion is reflected in the recommendations contained in Elwood's (1977) report.

Subsequent to publication of the report, laboratory management was advised of the importance of and need for carrying out these recommendations (Appendix 4). The Abstract, Introduction, Recommendations, and Distribution List from the Elwood (1977) report are included as Appendix 3. Six memoranda relating to this report are included as Appendix 4.

INTERACTIONS WITH TVA

On May 4, 1977, two members of the DOE (then ERDA) Environmental Protection Branch and a member of the UCC-ND HSEA staff met with representatives of TVA's Division of Environmental Planning at TVA's offices in Chattanooga to provide TVA with the raw data then available on mercury in Poplar Creek and Clinch River fish. The group requested that TVA make a comparative assessment of the data with the TVA ongoing program for measuring mercury in fish in all of its reservoirs, and suggested that TVA consider incorporating these waters in their ongoing monitoring program. A positive interest was expressed in the suggestion, but it was indicated that internal discussions and budget review would be required before a decision on the matter could be reached.

Subsequent correspondence from TVA (letter from Brooks to Hart, dated August 2, 1977) to DOE (ERDA) indicated an agreement to design and implement a sampling survey in the Melton Hill Reservoir/Clinch River area in the vicinity of ORNL; however, later correspondence (letter from Brooks to Hart, dated March 27, 1978) stated that after a review of the rather extensive data base sent to them, they saw no need to collect any additional samples in Calendar Year 1978 and suggested that the situation be reappraised in January 1979 to determine the need for additional sampling.

ESD CONCERNS OVER MONITORING OF AQUATIC ENVIRONMENTS AT DOE-OAK RIDGE FACILITIES

During the course of the 1977 study of mercury contamination in Poplar Creek and the Clinch River, the ESD staff members involved reviewed available monitoring reports for DOE-Oak Ridge facilities to locate mercury data. They found a lack of data on mercury in fish or other biota, problems in interpreting the sediment mercury data in these reports, and problems with some of the procedures and methods used in monitoring for mercury. For example, in attempting to interpret mercury levels in sediments collected in the vicinity of one of the DOE-Oak Ridge facilities (ORGDP), they found that the limited distribution of sampling locations, the lack of data on mercury in effluents, and the lack of information on sediment particle size precluded our distinguishing among variations in mercury levels due to (1) differences in mercury discharges from this facility, (2) differences in mercury transport from DOE facilities upstream, and (3) textural differences in the sediment samples. As a result of these problems in the monitoring program, the data were inadequate for identifying the source(s) of the mercury or for assessing the trends in mercury levels in the area of this DOE-Oak Ridge facility (ORGDP). Our questions about the monitoring programs were reflected in the recommendations in the Elwood (1977) report just described and were further elaborated in a memorandum dated September 9, 1977, from S. I. Auerbach to C. R. Richmond, Associate Director for Biomedical and Environmental Sciences at ORNL. A copy of this memorandum is included in Appendix 4.

ECOLOGICAL STUDIES FOR THE ENVIRONMENTAL ANALYSES OF ORGDP AND ORNL FACILITIES

In 1976, ERDA/ORO decided that an impact statement should be prepared on the operation of the Oak Ridge Gaseous Diffusion Plant (ORGDP). Staff in the Environmental Sciences Division (ESD) were to be responsible for assessing the impacts of ORGDP operations on the aquatic and terrestrial environs. A decision was made that insufficient ecological data were available for this assessment and that additional studies should be conducted. The justification and need for such a baseline ecological survey were provided in a previous report related to operation of all the Oak Ridge facilities (ERDA, 1975). A sampling program was designed by ESD staff and submitted to ERDA/ORO for approval in January 1977 (letter from Auerbach to Wing dated January 1977, see Appendix 5). Sampling was initiated in April 1977 and continued through September 1978. A portion of this sampling program consisted of collection of fish from Clinch River and Poplar Creek sites above and below ORGDP for trace element analyses, including mercury. No sampling was conducted in East Fork Poplar Creek. Data from the baseline ecological survey were used to prepare an environmental assessment (not an environmental impact statement) which was published in December 1979 (DOE, 1979; see Appendix 5 of this testimony for title page and table of contents). All of these data, including the information on mercury concentrations in fish, water, and sediments in the vicinity of ORGDP, were later published in a separate report (Loar, 1981; see Appendix 5 for title page, table of contents, and distribution list).

Similar procedures and rationale were followed for evaluating the impacts of operation of Oak Ridge National Laboratory. A sampling program similar to the ORGDP survey was submitted for ERDA/ORO approval in March 1977 (letter from Auerbach to Wing dated March 1977; see Appendix 5). Sampling was initiated in March 1979 and continued through June 1980. Mercury concentrations were analyzed in fish collected from the White Oak Creek watershed and the Clinch River.

These and other ecological data were published in a report (Loar et al., 1981; see Appendix 5 for title page, table of contents, and distribution list) that provided a basis for an evaluation of the impacts of ORNL operations on the aquatic environs. This evaluation (or environmental analysis), which was not an environmental impact statement, was published in November 1982 (Boyle et al., 1982; see Appendix 5 for title page, table of contents, and distribution list).

ACTIVITIES IN 1982 AND 1983

Starting in April 1982 and continuing through the present, the Environmental Sciences Division has been involved in a number of activities for the Y-12 Plant related to the mercury contamination problem. The purpose of this section is to briefly highlight these activities. Supporting material is included in appendices.

Study to Determine Mercury Concentrations in East Fork Poplar Creek and Bear Creek in 1982

The Health, Safety, and Environmental Affairs Division at the Y-12 Plant requested the services of the Environmental Sciences Division in April 1982 to determine mercury concentrations in East Fork Poplar Creek and Bear Creek. The objectives of this study and assignment of responsibilities are summarized in an internal correspondence memorandum dated May 4, 1982 (See Appendix 6). We did not consider this short-term study in 1982 to represent a full implementation of the 1977 recommendations (Elwood, 1977) because of the limited scope and time frame of the study. The study was given high priority by both Y-12 and the Environmental Sciences Division and, as a result, the study was completed within a month and a draft report prepared for review before the end of May 1982. Van Winkle presented a briefing for Y-12 Plant Management on June 2, 1982 (see Appendix 7). The draft report received technical review by staff in the Environmental Sciences Division and the Health and Safety Research Division at ORNL and in the Health, Safety, and Environmental Affairs Division at Y-12. After technical approval by the appropriate managers at ORNL and Y-12, the final report was published on September 7, 1982. The Abstract, Introduction, Conclusions, Recommendations, and Distribution List from this report are included in this testimony as Appendix 8.

Mercury Concentrations in Fish in the Vicinity of ORGDP in 1982

At the same time we were performing the May 1982 study for Y-12, M. Mitchell, Head of the Environmental Management Department at ORGDP, requested the services of the Environmental Sciences Division in collecting fish upstream and downstream of ORGDP in Poplar Creek. The analyses were completed in October 1982 (see Appendix 9), but the results have not been interpreted or included in any report.

Survey of Drainage at Y-12

Results of the 1982 study (Van Winkle et al., 1982) confirmed that the Y-12 Plant area was still an active source of mercury to East Fork Poplar Creek. These results led immediately to discussion and design of further surveys for mercury contamination in drainage waters within the Y-12 Plant and investigations of the mass balance of mercury in New Hope Pond. The objective of these latter studies was to identify and characterize current sources of mercury entering East Fork Poplar Creek (see Appendix 10). The first phase of these additional studies was completed in fall 1982. Specific sources of mercury contamination were identified and a remedial action plan was developed and implemented to clean up these sources. Studies to further define the problem and to assess the effectiveness of clean-up measures are in progress. A draft interim report has been prepared by R. R. Turner of the Environmental Sciences Division and is currently undergoing technical review.

Mercury Concentrations in Hair and Other Tissues from Cows and Horses

Following up on Recommendation 3 in Van Winkle et al. (1982, p. 54) and in light of comments received during the review of this report (Appendix 11), hair samples were obtained in August 1982 from cows and horses, some of which were controls and some of which had been grazing on pasture grass in the contaminated floodplain of East Fork Poplar Creek and drinking water out of this creek. The rationale for sampling hair for mercury analysis is that mercury contamination of mammals, resulting from the consumption of contaminated food and water, is reflected in elevated levels of mercury in the hair of these animals. Due to suspected contamination of one of the hair samples during the chemical analysis, additional hair samples were obtained in November 1982. In addition, since one of the two cows sampled in November 1982 was being slaughtered for beef, samples of various other tissues (muscle, liver, and brain) were obtained for mercury analysis. These samples have been analyzed for total mercury, and preliminary results indicate no significant mercury contamination in the various tissues.

Literature Survey of Population Density Data for Selected Species of Sport Fish in Streams, Reservoirs, and Lakes

On October 18, 1982, G. J. Marciante, Environmental Protection Branch, Oak Ridge Operations Office, phoned J. W. Elwood regarding the feasibility of estimating the size of the bluegill population in East Fork Poplar Creek. Elwood suggested that quantitative estimates of the population at four or five locations could be obtained within a two-week period. Discussion, however, led to a more limited request from the Health, Safety, and Environmental Affairs Division at Y-12 to perform a literature survey. The report prepared by J. W. Elwood was transmitted to Y-12 with a cover memorandum dated November 9 (see Appendix 12).

E. NEED FOR ADDITIONAL STUDIES AND MONITORING OF MERCURY IN THE VICINITY OF THE DEPARTMENT OF ENERGY FACILITIES IN OAK RIDGE

Based upon experience to date, there appear to be a need for additional studies and monitoring of mercury in the Oak Ridge environs. We suggest it is necessary (1) to determine the spatial extent and magnitude of the mercury contamination, (2) to identify the active and residual sources of mercury, and (3) to determine the changes in the level of contamination over time.

We suggest as a first step that the spatial extent and magnitude of mercury concentrations in the streams and reservoirs downstream of the three DOE facilities in Oak Ridge be determined from measurements of mercury in surface and subsurface sediments, and some work has already been initiated. Sediments are reliable indicators of mercury contamination because the bulk of the mercury in contaminated streams and lakes is associated with sediments and the background level of mercury in sediments is well documented. Sediment surveys must be carried out with due regard for the effect of sediment particle size distribution on mercury concentration. Most of the past surveys around the Oak Ridge facilities have neglected to consider particle size and, thus, much of the historical data cannot be fully interpreted.

To document the spatial extent of contamination from the Y-12 Plant, we suggest that sediment sampling extend from the Y-12 discharge into New Hope Pond downstream into the Clinch River (Watts Bar Reservoir), at least to its confluence with the Emory River near Kingston, Tennessee. A survey of mercury in sediments will provide information on (1) how far downstream of the three DOE facilities in Oak Ridge the mercury contamination has spread, (2) the level of contamination of surface sediments from which biological organisms (e.g., fish) can accumulate mercury, (3) current levels of mercury in sediments at reference sites that can be sampled over time to establish temporal trends in mercury concentrations throughout the area, and (4) the location of any sizeable quantities of sediment-bound mercury that may need to be removed from streams because of the biological availability of the mercury to aquatic organisms and/or because of the susceptibility of the contaminated sediments to resuspension and transport, resulting in the downstream spread of contamination.

Regular sampling of mercury in sediments can also assist in identifying active sources of mercury discharges. Such a study would provide an inventory of the mercury associated with sediments in East Fork Poplar Creek, the stream in which mercury contamination appears to be most severe. Such an inventory is essential for assessing the role of residual mercury in subsurface sediments of East Fork Poplar Creek, derived from past releases, in sustaining surface sediment contamination. Based on an analysis of the current discharge of mercury from New Hope Pond and on the observed pattern of mercury concentrations in sediments and fish in East Fork Poplar Creek downstream of this pond in 1982, it is suggested that the current concentrations in surface sediments in East Fork Poplar Creek can be explained by the current discharge of mercury (about 1 to 2 oz/day) from the Y-12 Plant area. Resolution of the issue of the importance of past versus current mercury releases is germane to planning actions for reducing the mercury contamination in surface waters.

A study should also be conducted of mercury concentrations in the floodplain of East Fork Poplar Creek. This floodplain, portions of which are known to contain mercury above background levels, is contiguous with residential areas and recreational facilities in the City of Oak Ridge, and commercial and residential development adjacent to the floodplain is increasing. In addition, the floodplain is used for grazing a few cattle and horses. At least one family obtains its beef from cattle that graze on this floodplain and that drink water from East Fork Poplar Creek. One cow sampled from this area showed no significant mercury contamination in edible tissues. We suggest that this area be sampled to determine the level of mercury in soil and grasses on the floodplain, in air above the floodplain, and in hair of livestock (horses, cattle) grazing on the floodplain. Because of the possibility that mercury-contaminated sediments dredged from East Fork

Poplar Creek have been used in gardens, studies should also be conducted to determine the concentration of mercury in vegetables grown in these soils.

Finally, we suggest that a regular biological sampling program be initiated to determine the level of mercury in fish and other edible aquatic organisms in local streams and reservoirs. Such sampling should be done on a regular basis at selected sites, including uncontaminated tributaries, to establish temporal trends in mercury levels of aquatic organisms consumed by humans. We also suggest that a study be conducted to measure the density of sport fish in East Fork Poplar Creek where mercury levels in fish from the upper portions of the drainage currently exceed the FDA action level for mercury of 1.0 ppm (Appendix 12). Such a study would provide information on the number of catchable fish available to sport fishermen, and hence, the potential public health risk from the consumption of fish from this stream. This study would also provide baseline data on both mercury levels in fish and density of fish for comparison with data collected after the new sewage treatment plant on East Fork Poplar Creek begins operation. The operation of this sewage treatment plant is expected to significantly improve water quality in the stream. When this occurs, fish populations that are currently limited by poor water quality due to discharges from the old sewage treatment plant are likely to increase. This could, in turn, result in increased harvest of sport fish from East Fork Poplar Creek.

We suggest that results, including discussion, interpretation, and conclusions, from all subsequent studies and monitoring of mercury (and other contaminants) in the vicinity of the DOE facilities in Oak Ridge be published in a form useful to the public and the scientific community.

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BIOGRAPHICAL INFORMATION

CHESTER R. RICHMOND

Dr. Chester R. Richmond is the Associate Laboratory Director for Biomedical and Environmental Sciences at the Oak Ridge National Laboratory (ORNL). Dr. Richmond is responsible for all biomedical and environmental research supported by the Department of Energy (DOE) at ORNL. He also is responsible for related research sponsored at ORNL by other Federal agencies, including the National Science Foundation, the Environmental Protection Agency, and the Departments of Agriculture, Interior, and Health and Human Services. Four research divisions—Biology, Environmental Sciences, Health and Safety Research, and Information Research and Development, as well as the Life Sciences Synthetic Fuels Program—report to Dr. Richmond. The divisions contain a total of approximately 610 people. The multidisciplinary research programs in the biomedical and environmental sciences involve (a) biological studies of carcinogenic, mutagenic, and toxicological effects, including repair, of chemical and physical agents associated with energy and other technologies, (b) ecological studies of the effects of energy technologies on particular ecosystems, (c) assessments of present and future effects of energy-related products and byproducts, and (d) studies of the physics, chemistry, and quantitative measurement of these materials in the environment and the work place.

In May 1981 Dr. Richmond also became the Director of Health, Safety, and Environmental Affairs for Union Carbide Corporation's Nuclear Division.

Before joining ORNL in 1974, Dr. Richmond was Alternate Health Division Leader at the Los Alamos Scientific Laboratory (LASL). His research at LASL led to his being awarded an E. O. Lawrence Award in 1974 for "research in radiation biology of internally deposited radionuclides and outstanding contributions to the resolution of radiation protection problems." Dr. Richmond received the Radiation Research Society Award and delivered the G. Failla lecture in 1976. He is the author of more than 100 publications on radiobiology and health and environmental effects of energy production. He received his B.A. in Biology from New Jersey State College at Montclair and his M.S. and Ph.D. in Biology-Physiology from the University of New Mexico in Albuquerque. Since 1975, he has been a professor at The University of Tennessee/Oak Ridge Graduate School of Biomedical Sciences.

Dr. Richmond is a member of the International Commission on Radiological Protection Committee 2 on Secondary Limits and the International Radiation Protection Association. He is also a member of the U.S. National Council on Radiation Protection and Measurements. He has served on panels and coauthored reports for the International Atomic Energy Agency, the International Commission on Radiological Protection, and the Organization for Economic Cooperation and Development.

Dr. Richmond was the U.S. Scientific Advisor to the International Symposium on Health Impacts of Different Sources of Energy sponsored by the World Health Organization, the United Nations Environment Program, and the International Atomic Energy Agency in June 1981. He has served on the panel of the National Research Council Planning Conference on Synthetic Fuels and a Federal Interagency Task Force on Uranium Mining Hazards. Currently, he is a member of the U.S. DOE's Energy Research Advisory Board's Light Water Reactor Safety Research and Development Panel and represents ORNL on the Federal Interagency Task Force on Acid Precipitation.

Dr. Richmond currently serves on the advisory board for the Society for Risk Analysis. He is a Fellow of the American Association for the Advancement of Science and a member of Sigma Xi and numerous other professional societies.

January 1983

Biographical Sketch

of

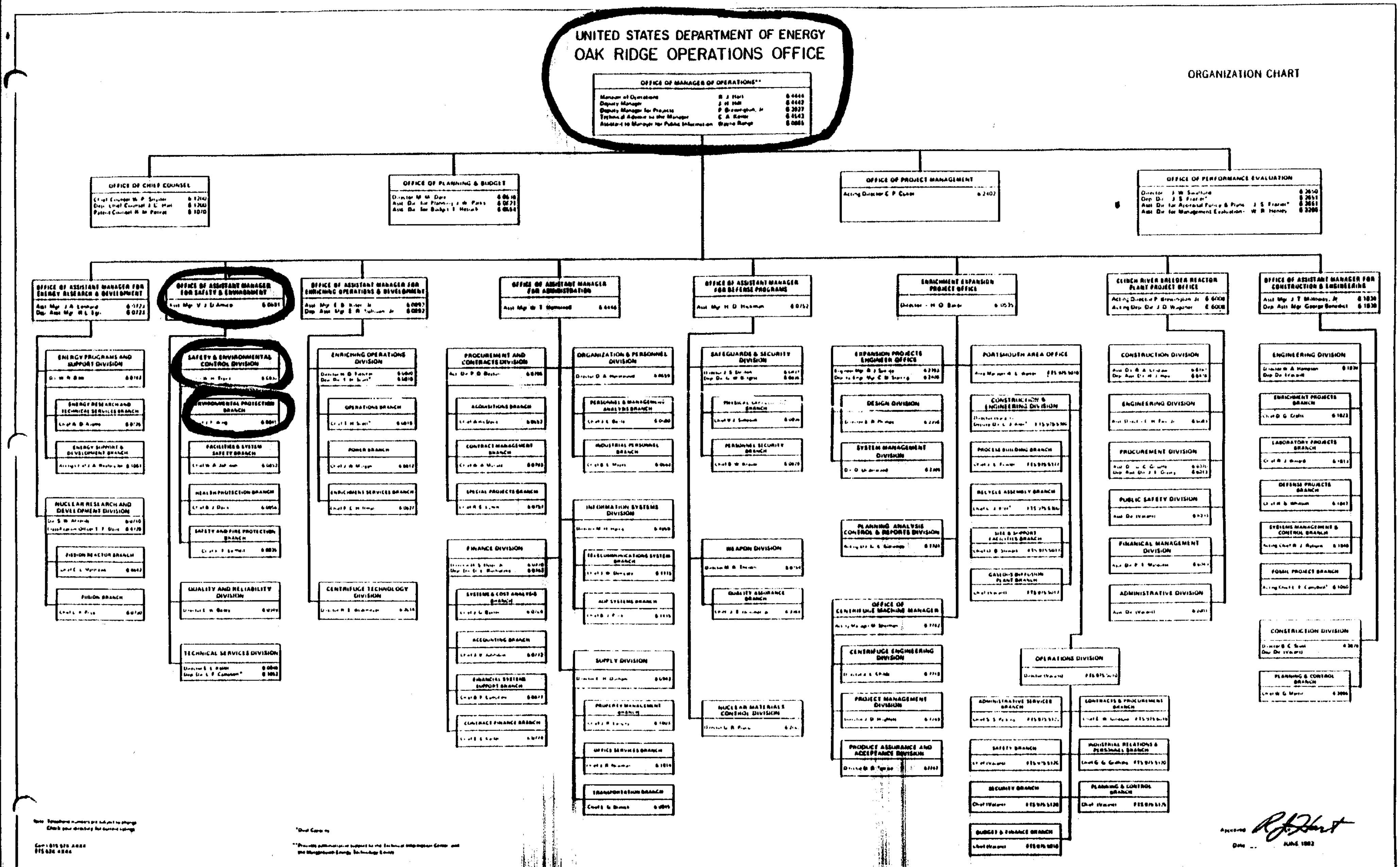
Stanley I. Auerbach

Dr. Stanley I. Auerbach is the Director of the Environmental Sciences Division of the Oak Ridge National Laboratory.

He was born in Chicago, Illinois, on May 21, 1921. He received his B.S. degree and M.S. degree in zoology, specializing in ecology, from the University of Illinois in 1946 and 1947, respectively. His advanced graduate studies in ecology were done at Northwestern University, Evanston, Illinois. He received his Ph.D. from this institution in 1949. Following a year of postdoctoral studies, he joined the staff of Roosevelt University in Chicago, Illinois, where he served as instructor and assistant professor of biology until 1954. That year he joined the staff of the Health Physics Division of the Oak Ridge National Laboratory as a research ecologist. Under his direction, the ecological research program of Oak Ridge National Laboratory has developed into one of the largest units in the world devoted to research in ecology and environmental sciences. The Environmental Sciences Division is recognized worldwide for its interdisciplinary programs in ecosystem analysis, radiation ecology, and studies in the biogeochemistry and cycling of elements. He has been the President of the Ecological Society of America (1971-72) and, in addition, has been a member or chairman of a number of advisory committees in the National Academy of Sciences and in government agencies. He is a Fellow of the American Association for the Advancement of Science and is listed in Who's Who in America. He is a member of the following professional societies: American Institute of Biological Sciences, American Society of Agronomy, American Society of Zoologists, British Ecological Society, Ecological Society of America, Entomological Society of America, Health Physics Society, Nature Conservancy, Society of Systematic Zoology, and Wilderness Society. He has held numerous committee and officer posts in several societies and in the National Academy of Sciences. His research interests encompass effects of ionizing radiation on the environment; transport and effects of radionuclides in the environment; radioactive waste management; energy and environmental impacts; and ecosystem analysis.

APPENDIX 1

ORGANIZATION CHARTS FOR DOE/ORO, UCC-ND, ORNL, Y-12, & ORGDP, HIGHLIGHTING THOSE ORGANIZATIONAL UNITS WITH RESPONSIBILITY FOR ENVIRONMENTAL AFFAIRS



UNITED STATES DEPARTMENT OF ENERGY
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ORGANIZATION CHART
OFFICE OF MANAGER OF OPERATIONS**
OFFICE OF CHIEF COUNSEL
OFFICE OF PLANNING & BUDGET
OFFICE OF PROJECT MANAGEMENT
OFFICE OF PERFORMANCE EVALUATION
OFFICE OF ASSISTANT MANAGER FOR ENERGY RESEARCH & DEVELOPMENT
OFFICE OF ASSISTANT MANAGER FOR SAFETY & ENVIRONMENT
OFFICE OF ASSISTANT MANAGER FOR ENRICHING OPERATIONS & DEVELOPMENT
OFFICE OF ASSISTANT MANAGER FOR ADMINISTRATION
OFFICE OF ASSISTANT MANAGER FOR DEFENSE PROGRAMS
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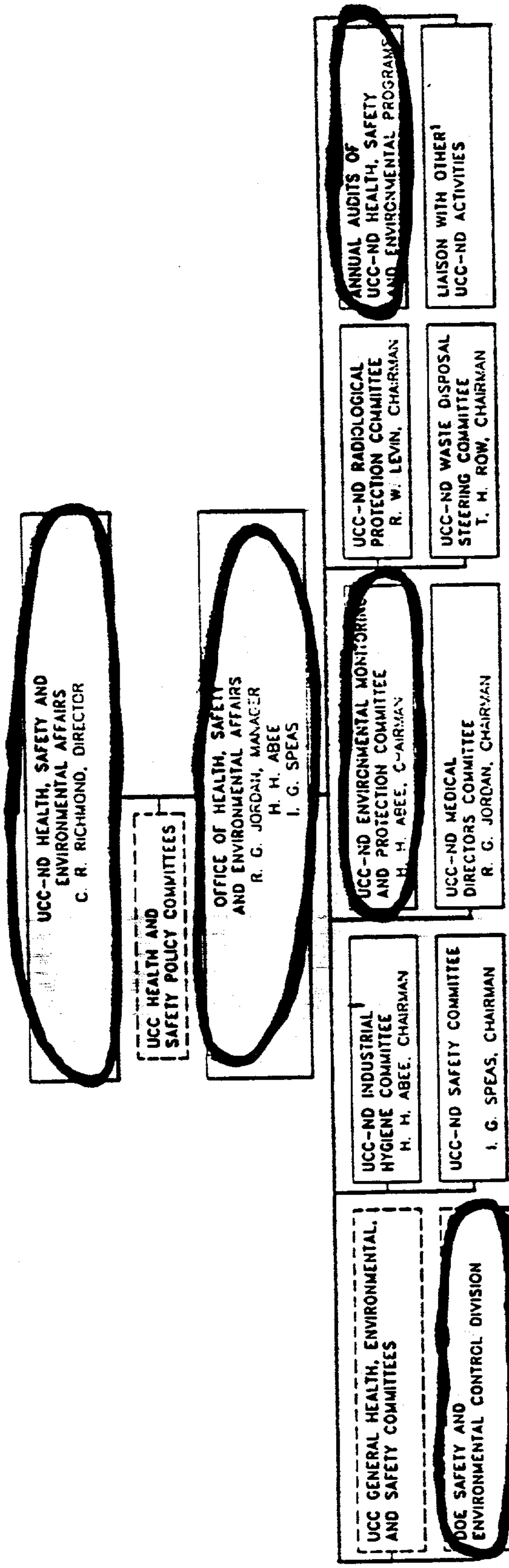
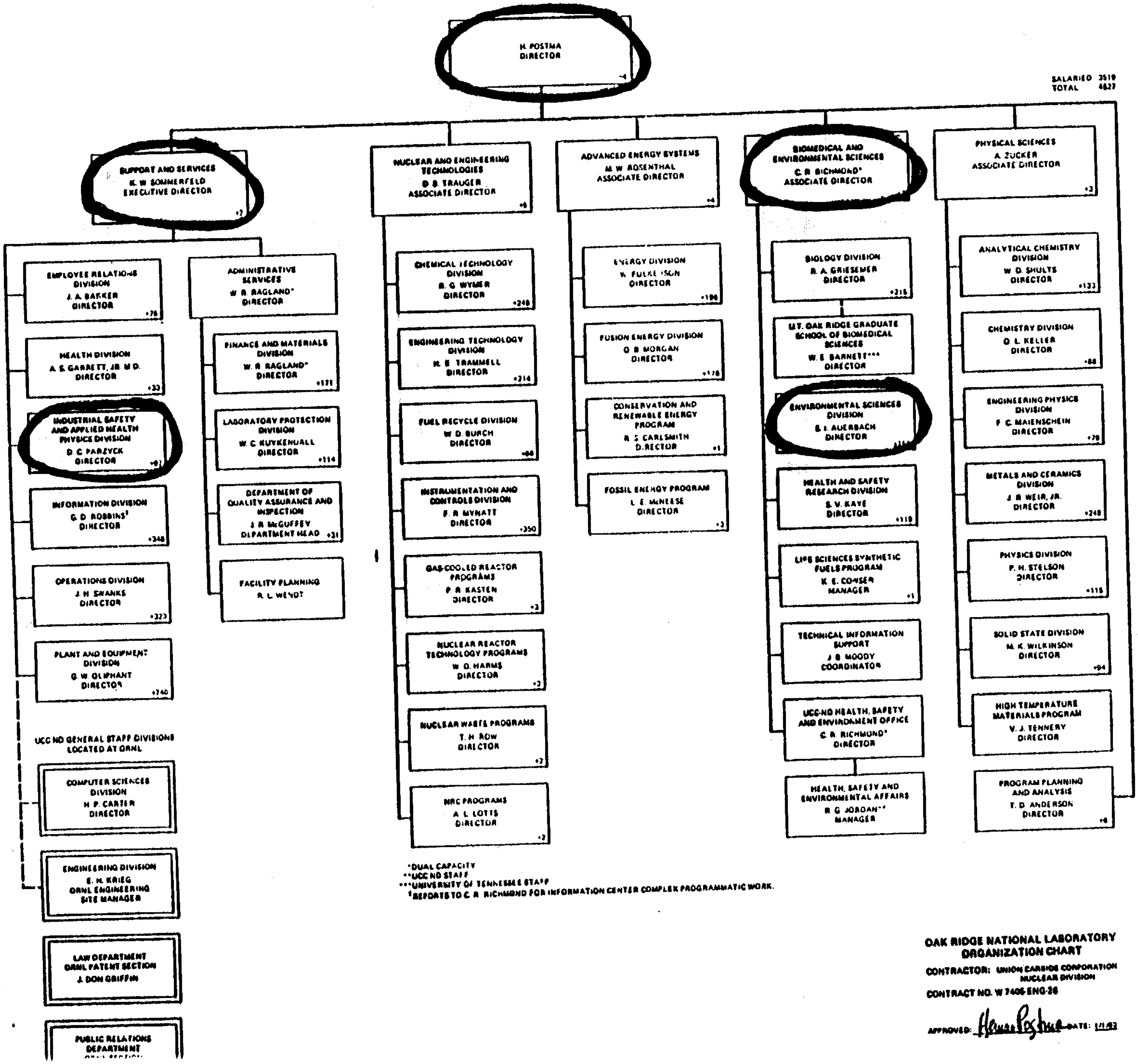
LABORATORY PROJECTS BRANCH
DEFENSE PROJECTS BRANCH
FOSSIL PROJECT BRANCH
JUNE 1982



[1] FOR EXAMPLE, BIOHAZARDS COMMITTEE AND NUCLEAR CRITICALITY GROUP



*DUAL CAPACITY
**UCC ND STAFF
***UNIVERSITY OF TENNESSEE STAFF
†REPORTS TO C. R. RICHMOND FOR INFORMATION CENTER COMPLEX PROGRAMMATIC WORK.

OAK RIDGE NATIONAL LABORATORY
ORGANIZATION CHART
CONTRACTOR: UNION CARBIDE CORPORATION
NUCLEAR DIVISION
CONTRACT NO. W 7405 ENG 26

APPROVED: Herman Postma DATE: 1/1/83

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[2]COMPUTER SCIENCES DIVISION
[3]ENERGY DIVISION
[4]FINANCE AND MATERIALS DIVISION
[5]INFORMATION DIVISION
[6]OPERATIONS DIVISION
[7]PLANT AND EQUIPMENT DIVISION
[8]ORAU POSTDOCTORAL FELLOW
[9]UNIVERSITY OF TENNESSEE
[10]ENVIRONMENTAL QUALITY BOARD OF PUERTO RICO

NUCLEAR DIVISION
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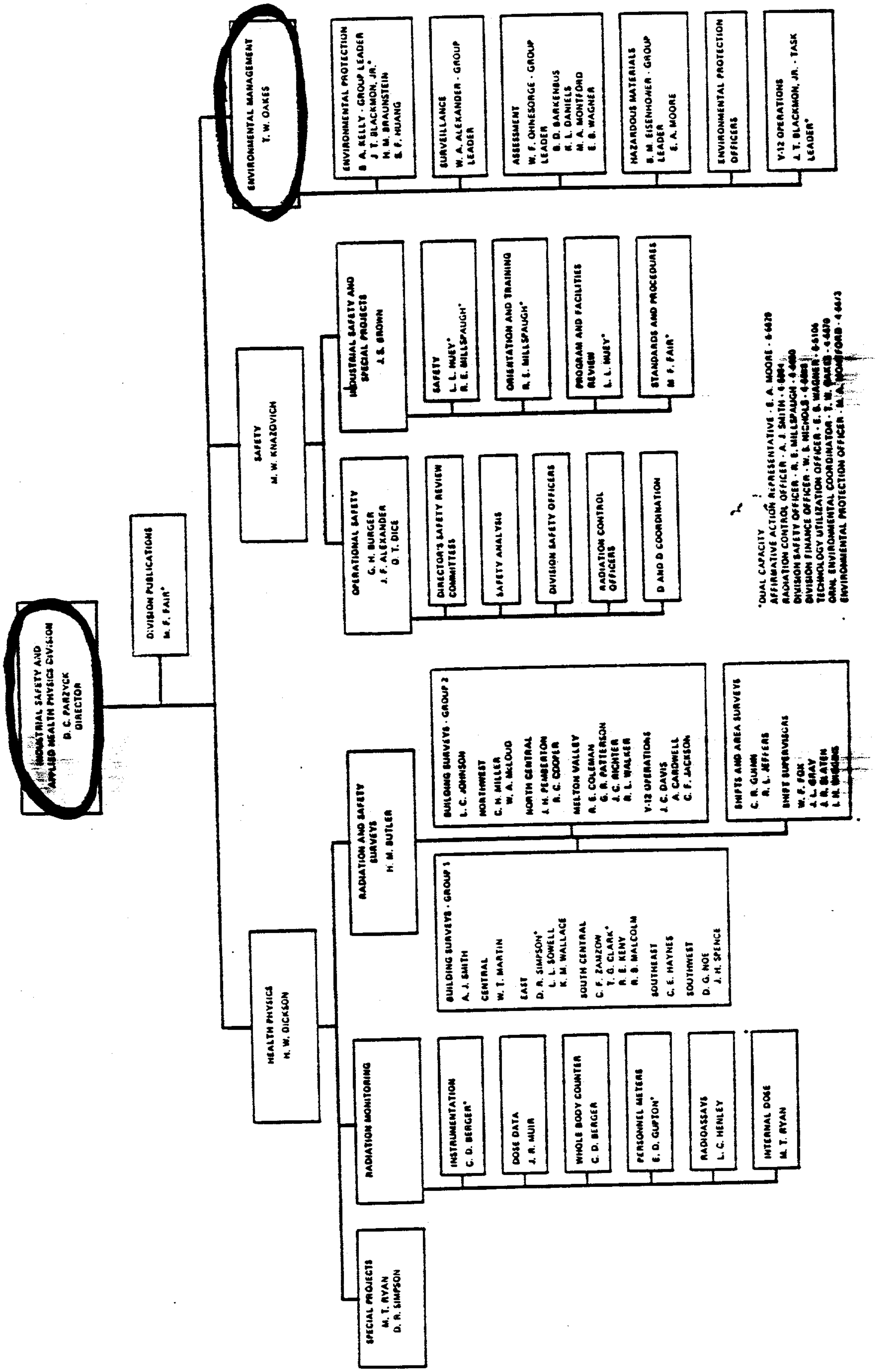
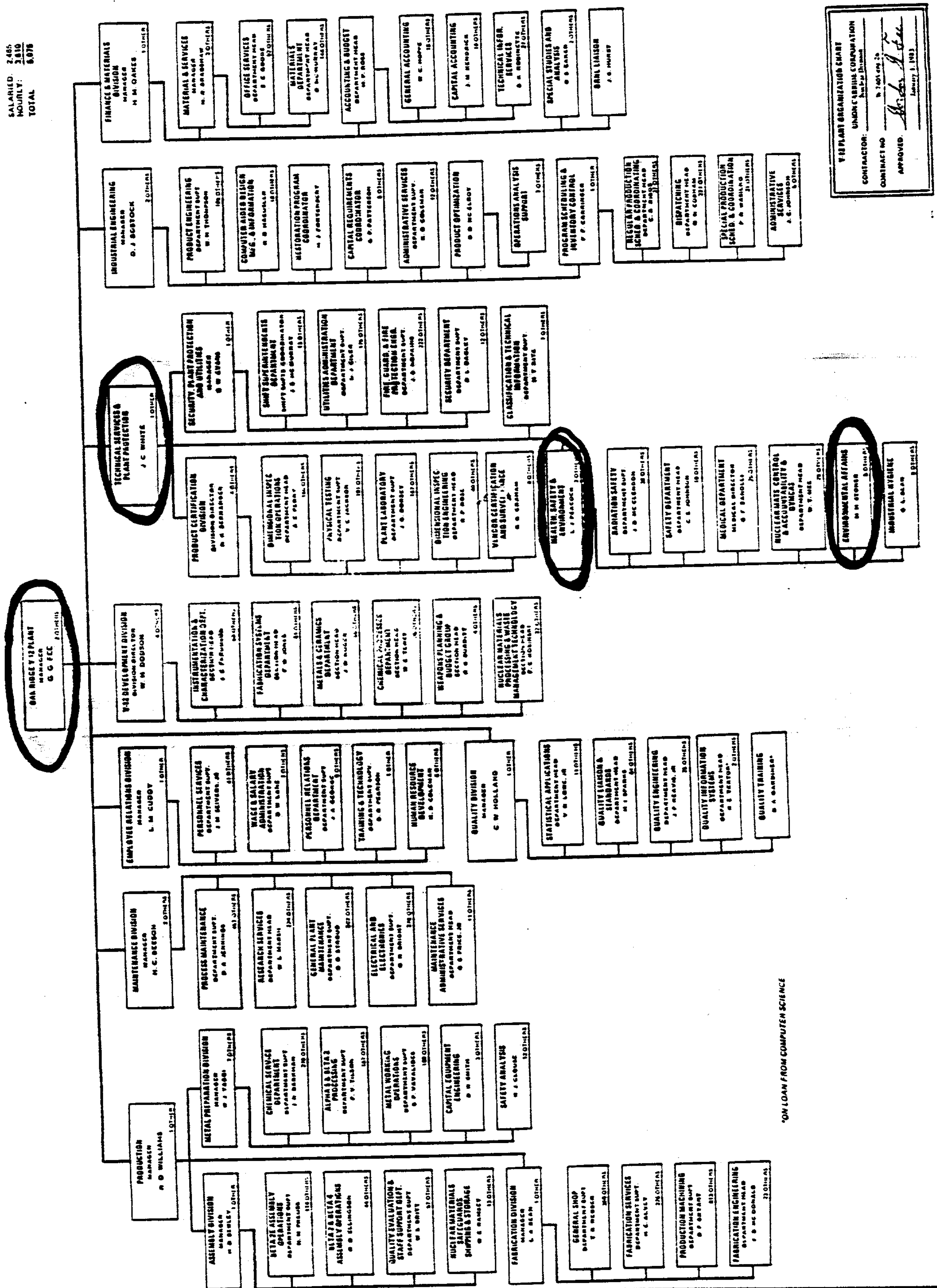
OAK RIDGE NATIONAL LABORATORY





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HOURLY: 3,610
TOTAL 6,075
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MANAGER
R D WILLIAMS
ASSEMBLY DIVISION
METAL PREPARATION DIVISION
FABRICATION DIVISION
MAINTENANCE DIVISION
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H. C. BEESON
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RESEARCH SERVICES
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MAINTENANCE ADMINISTRATIVE SERVICES
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HEALTH, SAFETY & ENVIRONMENT
RADIATION SAFETY
SAFETY DEPARTMENT
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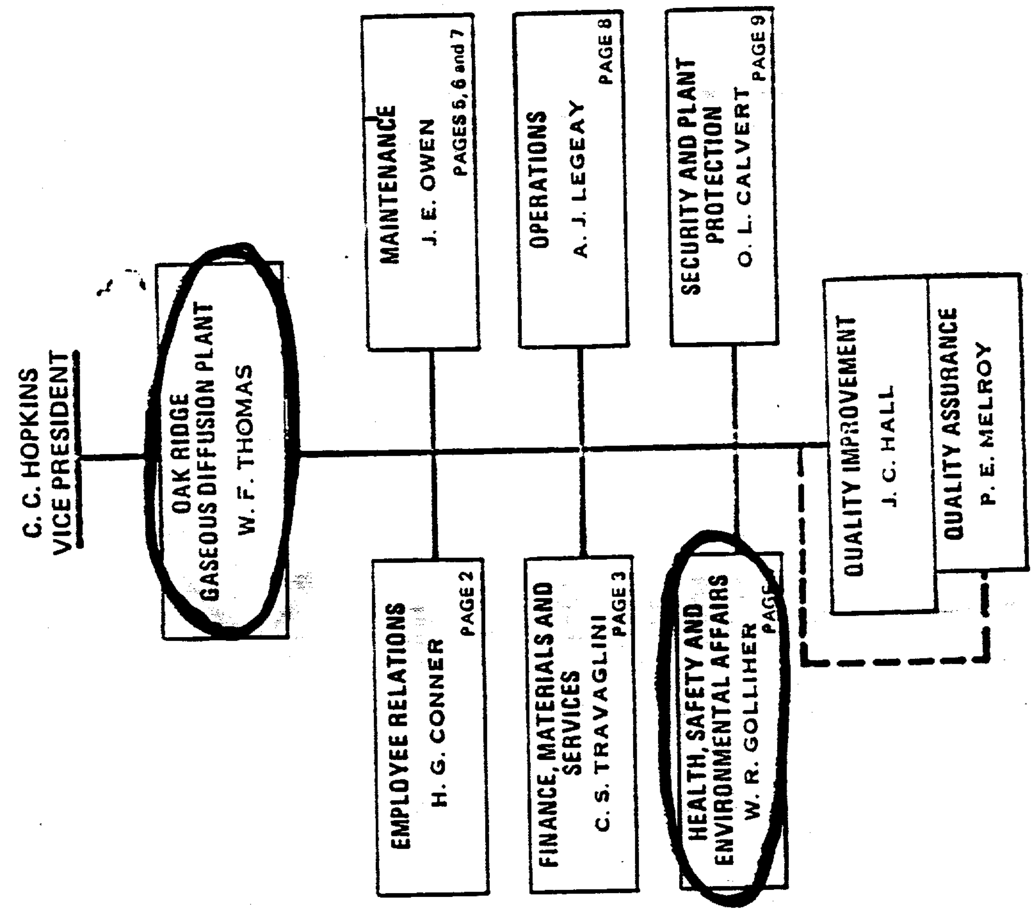
CONTRACT NO.
APPROVED:
January 1, 1983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VICE PRESIDENT
OAK RIDGE GASEOUS DIFFUSION PLANT
W. F. THOMAS
MAINTENANCE
J. E. OWEN
PAGES 5, 6 and 7
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A. J. LEGEAY
PAGE 8
SECURITY AND PLANT PROTECTION
O. L. CALVERT
PAGE 9
EMPLOYEE RELATIONS
H. G. CONNER
PAGE 2
FINANCE, MATERIALS AND SERVICES
C. S. TRAVAGLINI
PAGE 3
HEALTH, SAFETY AND ENVIRONMENTAL AFFAIRS
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QUALITY IMPROVEMENT
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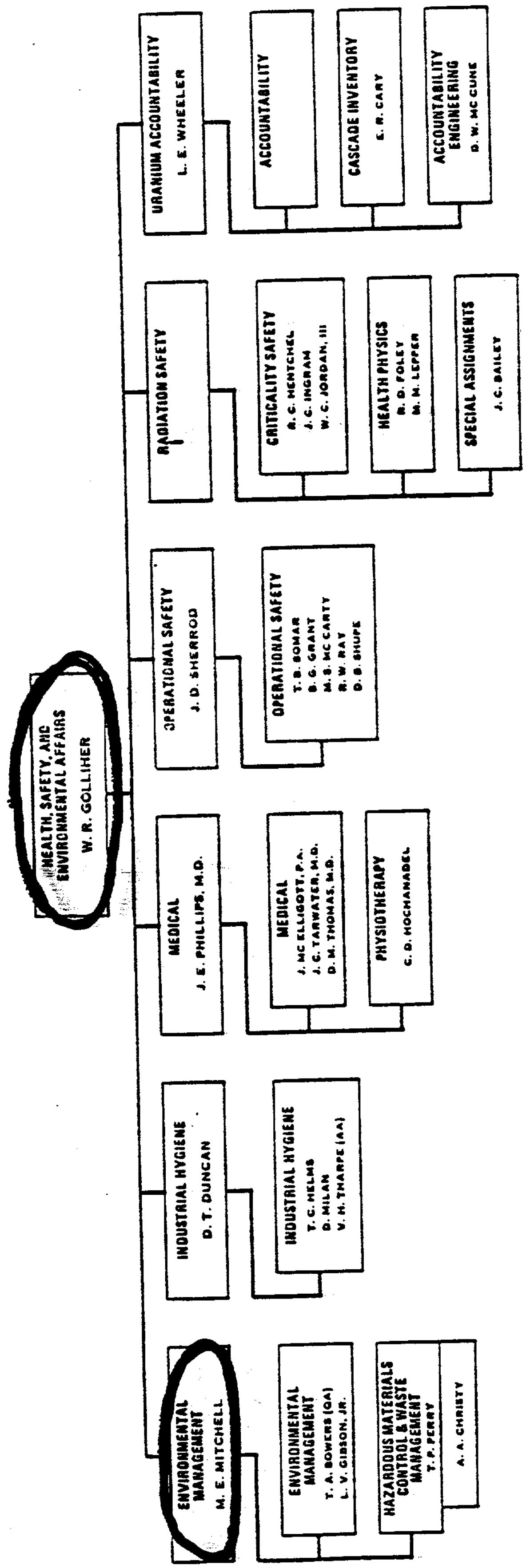

(AA) AFFIRMATIVE ACTION REPRESENTATIVE
(QA) QUALITY ASSURANCE COORDINATOR

APPENDIX 2

CORRESPONDENCE RELATING TO THE AQUATIC MONITORING PROGRAM
FOR ENVIRONMENTAL ANALYSES OF THE
Y-12, ORNL, CARL, and ORGDP FACILITIES (1974-1975)

Memorandum from S. I. Auerbach to W. Fulkerson, dated October 15, 1975
Memorandum from J. W. Elwood to E. G. Struxness, dated November 20, 1975
Memorandum from J. W. Elwood, S. G. Hildebrand, and L. D. Eyman to S. I. Auerbach, dated November 26, 1975
Letter from R. F. Hibbs to R. J. Hart, dated December 2, 1975

A7-8.5

Plant (O.R.) comments

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

1975 NOV 20 AM 11 27

November 20, 1975

Distribution by S. I. Auerbach

TO: E. G. Struxness

FROM: J. W. Elwood JWE

SUBJECT: Review of Preliminary Draft Environmental Analysis (PDEA), Oak Ridge-ERDA Operations, Volumes II, III, IV, VI, VII, and VIII.

I have concentrated my review on those sections of the six volumes listed above that deal with non-radiological liquid effluents and their impacts on aquatic environments. My detailed comments are on the six volumes I reviewed. The purposes of this memo are to (1) give you my general critique of this draft environmental analysis and (2) outline what should be done to upgrade this PDEA to a draft environmental impact statement.

Qualitative and quantitative characterization of several liquid effluent streams (Volumes II, III, and IV) are incomplete in terms of identifying constituents in effluents, specifying maximum instantaneous concentrations of constituents (rather than average maximum of composited samples), total amounts released to the environment, and types and duration of releases (i.e., continuous vs. intermittent discharges). In addition, locations of some point source discharges and source areas for diffuse source terms are not described. This is particularly true for some effluents at the ORNL, X-10 site, such as location of storm drains which receive cooling tower blowdown and exact locations of septic tanks and their drain field. Almost without exception, legends of tables containing effluent and water quality data do not indicate in sufficient detail what is contained in the table. Much of the effluent and water quality data are not cited or used in the ecological assessment (Volumes VII & VIII) and thus the reason for its presence in the PDEA is not apparent.

The assessment of non-radiological liquid effluents on aquatic environments is based primarily on data collected in the limited environmental sampling program described in Appendix 2.I of Volume VI. I have raised several questions concerning the validity and interpretation of much of the biological and chemical data collected in this sampling program. Reported concentrations of several metals, for example, are based on analysis of water samples filtered through 0.8μ filters. The defined separation of the dissolved and particulate fraction as specified by EPA (1974) is based on filtration through a 0.45μ filter. According to data in the PDEA, concentrations of several metals, in some streams, including "control" streams, on the Oak Ridge Reservation exceed EPA water quality guidelines. In view of the particulate contamination known to result from filtration through 0.8μ filters, most if not all of the reported excess concentrations of metals are open to question. I personally would not use the data for assessing impacts on aquatic biota. Discussions regarding the bioaccumulation of heavy metals in aquatic food chains are naive. While this aspect should be included in the DEIS, the data presented in the PDEA are not adequate to draw any conclusions. My overall view of the assessment sections of the PDEA dealing with aquatic environs is that they are poor. Most of the conclusions drawn cannot be supported with the data presented in the PDEA. There is some obvious uncritical use of environmental data without really knowing what the data are based on (e.g., number and location of samples, methods of sample collection, preparation, and analysis). It was apparent to me that individuals responsible for assessing the non-radiological liquid effluents had not familiarized themselves with the data, (i.e., talked to individuals responsible for its collection and analysis) and were not aware of all environmental data available for this area (e.g., TVA water quality data on the Clinch River). Because monitoring of surface waters downstream of point source effluents is much less intensive than is effluent monitoring, the fate of constituents in downstream ecosystems receives little attention in the PDEA. Why, for example, is there no mention of plutonium below White Oak Lake? Hopefully situations such as this will be remedied by the environmental sampling program we have proposed. There is, however, sufficient data to look at some gross changes in water quality within some of the drainages receiving effluents from Oak Ridge-ERDA facilities. This is a matter of reorganizing the assessment in the PDEA to look at entire drainage-basins (i.e., summing all effluents from each major facility and comparin water quality upstream and downstream of the combined source terms). Volumes VI, VII and VIII of the PDEA will require a major rewrite before it is ready to be released. Before the revision is initiated, however, the present organization of the PDEA should be reviewed. My patience was continuously tested in searching for table, figures, descriptions of effluents, and descriptions of facility operation that were cross referenced. It is, in my judgement, a difficult document to read and follow simply because of the poor organization. To illustrate this with a typical example, facility operations and characterization of their effluents are described in one volume, assessment of these effluents is described in a second (and sometimes third) volume and the environmental data on which the assessment is based are given in a completely separate third (or fourth) volume. With the existing organization, this document should totally frustrate most readers interested in an environmental analysis of Oak Ridge-ERDA Operations. There is excess detail in many sections which needs to be excised. If this is done, the size of the document can be substantially reduced. Preparation of this document for release will require more than editing. It will require analysis of data. re-organization of Volumes VI, VII, and VIII and a major rewriting of those sections dealing with the ecological assessment of liquid effluents.

Finally, data from the three-plant environmental sampling program we have outlined is essential before this document can be upgraded to a draft EIS. There is not sufficient biological and associated water quality data to do a meaningful assessment of effluents from the Oak Ridge-ERDA facilities. While I don't know what constitutes an official environmental analysis the PDEA for Oak Ridge-ERDA Operation has raised many questions which need answering. Even if it serves no other useful function, the PDEA has proven beneficial to me in designing a sampling program that hopefully will answer most of the questions it raises.

JWE:bt

cc: S. I. Auerbach
B. G. Blaylock

A7-8.5
W. Fulkerson AS-

1975 OCT 17 AM 11 24

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

October 15, 1975

To: W. Fulkerson

From: S. I. Auerbach

Subject: Environmental Monitoring Programs for ERDA's Facilities on the Oak Ridge Reservation

Members of my staff have reviewed the summarization of environmental monitoring programs for ERDA's Oak Ridge facilities tabulated under cover of a memorandum from R. B. Craig to T. H. Row dated September 19, 1975. We understand this summary was culled from the draft report on the so-called 3-plant survey, which report purports to assess the environmental impacts of ERDA's facilities in Oak Ridge, at least in a preliminary way. We understand further that consideration is being given to upgrading this report to the equivalent of a draft environmental impact statement (DES) in the near future. Does this mean that the preliminary findings in the present draft environmental report substantiate conclusions that are now to be regarded essentially as the "bottom line" (or nearly so) on the 3-plant impacts? Furthermore we do not agree that this part of the report (i.e., the Table on ERDA Non-Radiological Monitoring attached to Craig's memorandum) should be regarded as the "bottom line" on environmental monitoring -- neither as to the kind of program needed nor as to the justification for it.

The rationale for the selection of sampling frequencies is not at all apparent in several cases (e.g., quarterly analysis of water from Roger's Quarry for COD (page 3), weekly BOD determinations in sanitary effluents (page 5)), nor is the selection of elements or parameters to be monitored always clear (e.g., water from New Hope Pond contains Cr, dissolved solids, F, Li, P, and N but it isn't clear what the effluent is analyzed for). The recommended additions or changes are loosely worded (e.g., the recommendation relative to impingement at the top of page 2 -- what is meant by "check"? What is meant by "periodically"?). The types of samples are not always clear (e.g., water samples from New Hope Pond (page 3) -- are they weekly composite or weekly grab samples?). There is no mention of biological monitoring at all. Why? If the purpose of this monitoring program is to comply with standards and to protect the environment, the best means to check this is to also do some monitoring of important biological parameters.

We believe that a more thorough evaluation of current monitoring programs at the Oak Ridge-ERDA facilities should be made. Our examination of the programs reveals a definite lack of internal consistency in terms of parameters measured and sampling frequency.

We believe that a major ERDA establishment has the responsibility to develop and maintain monitoring programs that equal or exceed those required of the private nuclear industry. These programs should serve as a model to those nuclear industries for which we as a National Laboratory are helping to develop guidelines and standards. The monitoring programs should include: chemical monitoring at or near the point of discharge; monitoring of biological effects where concentrations exceed acceptable standards; and a system of monitoring that will be sensitive enough to function adequately when the as-low-as-practicable concept of releases is achieved by the Oak Ridge ERDA facilities. This is bound to come so long as NRC continues to regulate the utilities on this basis. ERDA should expect to abide by the same guidelines as its industrial counterparts.

As an example, the proposed surface water monitoring system should include the major points of release from the three facilities. The degree of monitoring at each point of discharge should reflect the chemical nature of the effluent, and where possible, this monitoring should be of a continuous nature (both strip chart recorders and proportional samplers). For example, parameters such as specific conductance, pH, dissolved oxygen, temperature, suspended solids, and specific ions such as NO_3, F, Cl, and SO_4 can be monitored continuously using in-stream electronic equipment. We believe these types of systems should be implemented at the sites identified in the attached Table 1. Additionally, current monitoring at these locations is inadequate since it does not reflect the existing hydrologic conditions in many cases. For example, one sampling station above and below the ORGDP on Poplar Creek and above and below the confluence of Poplar Creek in the Clinch River will not yield the information necessary to determine the source or amount of contaminants released from these facilities. The reverse flows in both the Clinch River and Poplar Creek, due to fluctuations in the level of Watts Bar Reservoir, make determinations of total input impossible. Therefore, it is essential that monitoring be established at the locations listed in Table 1 for the ORGDP. An alternative solution would be to combine these effluents and discharge them through a single treatment facility. This would allow an assessment of the combined effluent and quality and provide a means of determining potential hazard to man and biota prior to release.

It has been established that heavy actinides are being released from all facilities. However, the current monitoring system does not provide data on the magnitude of these releases. Also, at many locations, discharges of non-radioactive trace elements are not adequately monitored. Systems to test the biological effects of these effluents on resident fauna and flora prior to their release to receiving waters should be developed and implemented.

In addition to the establishment of a comprehensive, sensitive monitoring system, a detailed inventory of present levels of contaminants in sediments of the Clinch River, the White Oak Creek Drainage, and the Poplar Creek Drainage (including Bear Creek) should be conducted. This information is essential in determining the fate of prior releases and their potential effect on man and the environment. After the monitoring system has become operational and the sediment inventory established, sediments should be monitored periodically to assess changes in distribution and levels.

These modifications in the surface water monitoring system should be coupled to the establishment of ground-water monitoring systems of comparable scope. Ground-water monitoring systems should be installed near all radioactive and non-radioactive waste disposal areas. The nstallation of these systems should be preceded by detailed geologic and hydrologic studies of the industrial disposal sites. After implementation of the monitoring systems, the individual wells should be sampled at least on an annual basis. The monitoring data from the ground water system will provide advanced warning of impending ground-water releases of pollutants to the surface water system.

We believe that an adequate and candid assessment of Oak Ridge-ERDA facilities impacts would reach most if not all of these conclusions. That part of the present draft environmental report dealing with environmental monitoring does not meet that standard.

S. I. Auerbach

SIA:ms

cc: J. A. Auxier
J. A. Cox
C. R. Richmond
M. W. Rosenthal
E. G. Struxness

bc: T. H. Row
E. J. Witkowski

Table 1. Surface water monitoring locations

Y-12

New Hope Pond Outlet

Roger's Quarry

Bear Creek Below Burial Ground

Kerr Hollow Quarry

West End Sanitary Treatment Plant

X-10

White Oak Dam

White Oak Creek (above confluence with Melton Branch

Melton Branch

7904 Sanitary Treatment Plant

Sanitary Treatment Plant (Ion Exchange Facility)

ORGDP

Poplar Creek

K-1203 Sanitary Treatment Plant

K-1407-B Holding Pond

K-1410 Plating Facility

K-1B1 UF_6 Feed Facility

K-1007-B Holding Pond

K-901-A Holding Pond

K-1515 Settling Pond

A1-82

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

1975 NOV 26 PM 2 20

November 26, 1975

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TO: S. I. Auerbach

FROM: J. W. Elwood, S. G. Hildebrand and L. D. Eyman

SUBJECT: Proposed sampling program for the Oak Ridge Reservation

The purposes of this memo are to (1) document our contributions to the proposed environmental sampling program (see attachment) for the Oak Ridge Reservation and (2) inform you of potential requests for significant commitments of our time to explain and defend this proposed program to Union Carbide-Nuclear Division and ERDA and to standardize the methods of collection and analysis of environmental samples at all facilities. If such a program is approved but funded at a level lower than costs which we projected (see page 3 of attachment), this proposed program would have to be revised, presumably by us.

After Jerry Elwood reviewed the Preliminary Draft Environmental Analysis for Oak Ridge-ERDA Operations, he indicated that a biological and water quality sampling program was needed in order to obtain data necessary to satisfy the requirements for an Environmental Impact Statement under the ERDA format. Additionally, in response to a request from R. F. Hibbs, Union Carbide-Nuclear Division, to T. H. Row, ORNL-Energy Division, a review of current monitoring programs at Oak Ridge-ERDA facilities was carried out by L. D. Eyman and J. O. Duguid of the ESD. They concluded that existing programs had major deficiencies in scope and pointed out a number of internal inconsistencies in monitoring. At the request of E. G. Struxness, the proposal for an environmental sampling program was developed by the three of us, Carolyn Dinger and Marty Salk. Details of the proposal were outlined following a review of current non-radiological effluent and water quality monitoring programs and discussions with environmental control personnel responsible for monitoring at the three major ERDA facilities (Mike Mitchell from K-25, Merwin Sanders from Y-12, Ed Witkowski from X-10 and Newell Bolton from X-10). We emphasize that the proposal represents our general recommendations for parameters to sample, constituents to be analyzed, and locations for sampling stations but is subject to revision based on a more extensive review of current facility operations and existing monitoring data.

Because of time limitations in getting this proposal ready to submit to Oak Ridge Operations, we temporarily dropped other commitments in order to assist in the development. We were informed that you were aware of our involvement in the development of this proposal. Future requests for commitments of our time concerning work dealing with environmental sampling programs for the Oak Ridge-ERDA Operations, however, need to be clarified. It was apparent in our reviews and discussions with operations personnel that differences in philosophy at the three major ERDA facilities in Oak Ridge were reflected in significant differences in the scope, intensity, and quality control of effluent and environmental monitoring. We therefore urge that a periodic and independent review (i.e., exclusive of operations personnel at the Oak Ridge-ERDA facilities) of all environmental and effluent monitoring at local ERDA facilities be established. Furthermore, to ensure that the designated individuals or task group responsible for preparation of the draft environmental impact statement for Oak Ridge-ERDA Operations are fully aware of and agree on both the proposed environmental sampling program and suggested changes in current effluent monitoring, we suggest that they conduct their own review of proposed and existing programs. This will provide those individuals responsible for assessing the environmental impacts a voice in requesting that data are collected which in their judgement are necessary.

JWE:bt

J. W. Elwood

R. D. Egmon

J. S. Hildebrand

Attachment

cc: B. G. Blaylock (wo/attachment)
E. G. Struxness (wo/attachment)

A7-8

Distribution by S. I. Auerbach

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NUCLEAR DIVISION

P. O. BOX Y, OAK RIDGE, TENNESSEE 37830

1975 DEC 5 PM 3 27

December 2, 1975

United States Energy Research and
Development Administration
Oak Ridge Operations
P. O. Box E
Oak Ridge, Tennessee 37830

Attention: Mr. R. J. Hart, Manager

Gentlemen:

I am writing in response to your letter of July 16, 1975 in which you inquired about what would be needed to upgrade the Environmental Analysis of ERDA Facilities in Oak Ridge to the status of a draft environmental statement.

As you know, we have completed our review of "The Preliminary Draft Environmental Analysis of Oak Ridge-ERDA Operations". Copies have been given informally to J. F. Wing of your staff. We will consider this draft to be "Official Use Only" until it is approved by UCCND and ERDA. In our opinion the current document, with some modification and editing, can be issued as an ERDA-ORO publication. We estimate that it can be ready to distribute in six months.

This document generally meets the guidelines for environmental assessments described in 10 CFR 11.7a, where the purpose of the assessment is defined as providing a basis for judging whether or not an environmental statement should be prepared in accordance with the precept in section 102(2)(C) of NEPA. If it is determined that ERDA should prepare a draft environmental statement, 10 CFR 11.55 describes it as an objective and meaningful evaluation of actions and their reasonable alternatives in light of all environmental considerations. As defined, we assume the evaluation should be somewhat comparable to those prepared for nuclear power reactors or proposed facilities of equal magnitude.

We have reviewed all past and present monitoring programs conducted by Y-12, ORGDP and ORNL and information available from a preliminary sampling program. This review has led us to the conclusion that a more comprehensive sampling program will be required to upgrade the assessment to an environmental statement. This is contrary to the opinion expressed in our September 5, 1974 letter. While we currently have in hand much of the descriptive material necessary for a statement, essential data on surface water and biota characteristics are lacking. The three major facilities considered have all maintained monitoring programs for both radioactive and nonradioactive materials for many years. However, these programs have normally been directed at demonstrating compliance with local, state, and Federal standards, and as such, do not provide the more complete baseline data conventionally assembled for an environmental statement.

A comprehensive sampling program to characterize the surface water and biota is outlined in the attachment. The program is designed to cover calendar year 1976. It is essential that it extend for a one-year period to adequately account for the effects of seasonal variations. At the same time, the material relating to process releases should also be updated with a current status date of September 30, 1976. This sequence of activities would allow us to provide ERDA with a Draft Environmental Statement ready for public release on July 1, 1977.

An estimate of the total cost for the sampling program and the preparation of the draft environmental statement is enclosed. We recognize that the sampling program is costly, but it appears to be what is required for an adequate environmental statement. Since the program that we have laid out would start in January, we would like to discuss its implementation in the near future.

Your letter requested identification of any deficiencies in the routine environmental monitoring program. While some modifications to these programs have been identified by the assessment and are included as part of the proposed sampling program, we feel final recommendations of changes can best be made upon completion of this program.

We will be pleased to discuss this in more detail if you desire.

Sincerely yours,

R. F. Hibbs

R. F. Hibbs, President

RFH:THR:lg

Attachments

cc: P. C. Fourney
R. G. Jordan - RC
C. J. Parks
H. Postma
P. R. Vanstrum
File

bc: S. I. Auerbach ✓
F. L. Culler
W. Fulkerson
M. E. Ramsey
C. R. Richmond
M. W. Rosenthal
T. H. Row
E. H. Struxness

Proposed Sampling Program for Oak Ridge Reservation

The Preliminary Draft Environmental Analysis of Oak Ridge-ERDA Operations (PDES) identifies several point-source discharges to surface waters that exceed current recommended guidelines for potable waters and the protection of aquatic life. Non-point-source contaminants may also be adversely affecting water quality in some streams on the Oak Ridge Reservation. In addition to the adverse effects on water quality associated with current discharges, aquatic environs on and downstream of the Oak Ridge Reservation are being adversely affected by past releases of environmental pollutants. Levels of mercury in some fish species in Poplar Creek at K-25, for example, currently exceed the FDA limits of 0.5 ppm Hg for human consumption. The elevated mercury levels in fish and sediments in Poplar Creek are attributed to an accidental release of mercury from Y-12 several years ago. The distribution and magnitude of this mercury contamination downstream of Y-12 presently is unknown.

In order to assess both the environmental impact of non-radiological effluents on aquatic ecosystems and hazards to man from these discharges, a systematic, coordinated environmental sampling program of surface waters receiving effluents both directly and indirectly from Oak Ridge-ERDA facilities is proposed. Historic and current data from effluent monitoring programs at Oak Ridge-ERDA facilities are useful in calculating concentrations of known releases for determining compliance with water quality standards downstream of point-source discharges. To assess the environmental impact of effluents, however, constituents should be sampled for both concentration and total loading (i.e., flow weighted) at the point of release and downstream. The fate of non-radiological environmental contaminants should be determined by sampling particulates. In addition, systematic sampling of aquatic populations (benthos and fish) downstream of effluents needs to be done in order to assess the impact of discharges on aquatic ecosystems. Existing biological data from sampling programs described in the draft document consist of preliminary species lists of aquatic biota in streams and reservoirs that receive effluents from Oak Ridge-ERDA facilities. There currently is neither systematic biological sampling of aquatic populations on or downstream of the Oak Ridge Reservation nor monitoring of aquatic biota, such as fish, for non-radiological contaminants.

To obtain the data necessary to fully assess the environmental impact of Oak Ridge-ERDA Operations on surface waters on and downstream of the Reservation, we proposed that the existing effluent and water quality sampling programs conducted by the various facilities be upgraded and a biological sampling program for a one-year period be initiated at an early date. To facilitate monitoring the fate and affects of both planned and accidental discharges to the drainage basins on the Oak Ridge Reservation (i.e. Poplar Creek, including Bear Creek, White Oak Creek, McCoy Branch, Kerr Hollow Branch, and Scarboro Creek) and to the Clinch River, we propose that all environmental sampling programs for Oak Ridge-ERDA facilities be centrally coordinated. This will provide flexibility in sampling that is necessary to respond to changes in facility operations and environmental conditions. It will allow for the standardization of sampling procedures and methods of analysis at all facility operations. This will ensure that the data collected in all sampling programs are comparable. Wherever possible, existing sampling stations and facilities would be utilized. The general recommendations for sampling of aquatic environs are:

I. Poplar Creek Drainage Basin

A. East Fork Poplar Creek (EFPC)

1. EFPC-1 (New Hope Pond, Y-12): The current monitoring program includes continuous strip chart monitoring of water for pH and conductance, with continuous proportional sampling and analyses for Cr, Li, Hg, Zn, Pb, Fe, Cd, U, F, SO_4, total P, PO_4, total N, NO_3, TDS, suspended solids, and TOC. Upgrade the current monitoring program to also include the following:

a) analyze continuous proportional samples for Al, Cu, and Ni.

b) continuous strip chart monitoring of D.O.; the current program of daily grab sampling for D.O. is insufficient to enable measurement of minimum daily concentrations.

c) daily analyses of BOD and COD based on continuous proportional sampling.

2. EFPC-2: This temporary station should be located between the RUST Water Treatment Plant and the Oak Ridge Sewage Treatment Plant. Chemical analyses of water will demonstrate effluent contributions to EFPC from Rust Engineering Company. In conjunction with population studies, sediment analyses, and analyses of aquatic organisms, these data will provide sufficient data for an assessment of additive impacts from RUST and Y-12 discharges into EFPC.

The sampling program should include the following parameters:

a) continuous strip chart monitoring of H_2O for pH, D.O. and specific conductance.

b) continuous proportional samples, composited monthly and analyzed for suspended solids and those elements analyzed for at EFPC-1, since high concentrations of some of these constituents were measured during 1974 at a nearby station.

c) Biological sampling, as discussed in the introduction

1. Quarterly collection and analysis of benthic organisms and fish tissues for Hg, Cd, Pb, Zn, Cu, Cr, Ni and U.

2. Population studies of resident and non-resident organisms.

d) Chemical analyses of surface sediment samples for Hg, Cd, Pb, Zn, Cu, Cr, Ni and U.

3. EFPC-3: Temporary station, located downstream from the Oak Ridge Sewage Treatment Plant, to determine effluent contributions by this facility. Parameters sampled should include:

a) Analysis of same elements as at EFPC-1.

b) Continuous strip recordings of D.O., pH, and specific conductance.

c) continuous proportional samples, composited and analyzed for NO_3, NH_4, TDS and suspended solids.

d) Residual Cl, BOD, and COD should be analyzed daily, based on continuous proportional sampling.

4. EFPC-4: Temporary station located immediately upstream from the confluence with Bear Creek; results of chemical and biological sampling and analyses would indicate additive effects of all point source discharges on water quality, and aquatic organisms in East Fork Poplar Creek. Sampling should include the following:

a) continuous strip chart recording of pH, D.O. and specific conductance.

b) continuous proportional samples composited and analyzed for the same constituents measured in New Hope and Bear Creek.

c) Biological sampling and analyses (as discussed in introduction)

1. Quarterly collection of fish and benthos for heavy metal tissue analyses (Hg, Cd, Pb, Zn, Cu, Cr, Ni and U).

2. Quantitative population studies of resident and

d) surface sediment analyses for trace metals (quarterly).

5. EFPC-5: Temporary station located downstream from confluence with Bear Creek, to determine the relative effluent contributions of each creek, the resulting additive impacts on the aquatic environment in this portion of East Fork Poplar Creek, and an estimate of the chemical loading of Poplar Creek by East Fork Poplar Creek.

   The sampling program suggested would be identical to that for EFPC-4.

6. Control Station: Locate at existing weirs on Walker Branch; conduct chemical and biological sampling to enable assessment of aquatic impacts of point-source effluent discharges in East Fork Poplar Creek and Bear Creek based on comparisons with ambient conditions in an aquatic environment which is relatively isolated from effluent discharges. Since the head waters of EFPC and Bear Creek essentially consist of effluents, it is necessary to establish the control station on a separate but comparable stream. The similarity of EFPC, BC and Walker Branch with respect to geological and drainage characteristics would enable a valid comparison of environmental conditions in Bear Creek and East Fork PC with the ambient conditions of Walker Branch.

B. Bear Creek (BC)

1. BC-1: Temporary station located immediately downstream from Y-12 waste dump areas, to determine effluent loading and aquatic impacts of all discharges in Bear Creek in this area. Previous sampling below these discharges has indicated the sampling program should include the following:

   a) continuous strip chart monitoring of water for pH, D.O. and specific conductance.

   b) continuous proportional water samples, composited and analyzed for Cr, Li, Hg, Zn, Pb, Fe, Cd, U, F, SO_4, PO_4, total P, total N, NO_3, TDS, suspended solids and TOC; BOD and COD should be analyzed daily, based on continuous proportional sampling.

   c) biological sampling (see introduction)

      1. quarterly collection and analyses of benthic organisms and fish tissues for heavy metals specified in water samples (b above).

2. quantitative population studies of resident and non-resident organisms.

d) quarterly chemical analyses of surface sediment samples for heavy metals (b above).

2. BC-2 (Existing station on Bear Creek Road): The current monitoring program is identical to that for EFPC-1 (New Hope Pond). Upgrade this program to also include:

a) analyses for same parameters as at BC-1

b) continuous strip chart monitoring of D.O.

c) daily analyses of COD and BOD based on continuous proportional sampling

d) biological sampling

1. quarterly collection and analyses of benthic organisms and fish tissues for heavy metals.

2. quantitative population studies of resident and non-resident organisms.

e) surface sediment analyses for metals

C. Poplar Creek (PC)

1. PC-1 (located between the confluence with EFPC and Blair Bridge): The current monitoring program includes continuous strip chart monitoring of water for pH, D.O. and specific conductance, with continuous proportional sampling and analyses for Cd, CN, Cu, F, Hg, Mn, Ni, U, Zn, NO_3, SO_4, NH_4, TDS and suspended solids; sediment core samples are analyzed for trace metals. Upgrade this program to also include the following:

a) daily measurement of BOD and COD based on continuous proportional sampling, during periods of unidirectional flow in Poplar Creek, for a limited period of time. Continuous proportional sampling and analyses for Li.

b) Biological sampling

1. tissue analyses of benthic organisms and fish for Hg, Cd, Pb, Zn, Cu, Cr, Ni and U.

2. population studies of resident and nonresident organisms.

c) include surface sediment analyses in current core sediment sampling program (< 0.2µ particle size).

2. PC-2 (mouth of Poplar Creek): The current monitoring program is identical to that conducted at PC-1, and should be upgraded as such, to enable assessment of chemical and biological impacts of ORGDP effluent discharges in Poplar Creek.

3. PC-3: Temporary control station located on Poplar Creek upstream from the confluence with the East Fork of Poplar Creek and above the tidal influence caused by fluctuations in the level of Watts Bar Reservoir. This station will provide data on chemical loading to the lower end of Poplar Creek at K-25 from the main branch of Poplar Creek which receives acid mine drainage and sewage effluents. The sampling program suggested would be identical to that recommended for EFPC-4.

II. White Oak Creek Drainage Basin

A. White Oak Creek (WO)

1. WO-1* (downstream from sanitary waste treatment area): Establish a temporary station downstream from the effluent outfall to determine chemical loading and biological impacts of all ORNL outfalls on White Oak Creek. The sampling program should include the following:

a) continuous strip recording of pH, D.O. and conductance to demonstrate maximum and minimum concentrations /24 hrs.

b) daily analyses of BOD, COD, NH_4, suspended solids and residual chlorine based on continuous proportional sampling.

c) continuous proportional samples analyzed for Cr, Zn, Pb, Hg, Cd, NO_3, P, PCB's, Cu, Mn, and phenols to enable impact assessment of ORNL point source discharges on White Oak Creek water quality.

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*Current plans for ORNL monitoring include proposed stations on Melton Branch and White Oak Creek for continuous monitoring of pH. The location of the pH stations coincide with the locations suggested for MB-1 and WO-1 in this proposal; subsequent to approval and installation of the pH stations monitoring could be upgraded to include the recommended sampling program.

d) biological sampling between WO-1 and WO-2 (weir).

1. tissue analyses of benthos and fish for heavy metal concentrations (Hg, Cd, Pb, Zn, Cu, Cr, Ni and U).

2. population studies

e) surface sediment collection and analyses between WO-1 and WO-2, for Hg, Cd, Pb, Zn, Cu, Cr, Ni and U.

2. WO-2 (at existing weir): The current monitoring program includes continuous strip chart recording of pH, D.O., conductivity, temperature and flow. Upgrade this program to also include the same parameters and sampling frequencies for water quality analyses as discussed for WO-1, to determine effects of all point-source and non-point-source ORNL discharges on water quality of White Oak Creek.

B. Melton Branch (MB)

1. MB-1* (7904 sewage treatment plant): Current monitoring is conducted in the sewage outfall by non-proportional sampling; establish a temporary station downstream from the outfall and include the following sampling in order to determine instream impacts of the facility:

a) continuous strip recording of pH, D.O. and conductance to demonstrate maximum and minimum concentrations /24 hrs.

b) daily analyses of BOD, COD, NH_4, suspended solids and residual chlorine based on continuous proportional sampling.

c) continuous proportional samples analyzed for Cr, Zn, Pb, Hg, Cd, NO_3, P, PCB's, Cu, Mn, and phenols to enable impact assessment of ORNL point-source discharges on Melton Branch water quality.

d) Biological sampling between MB-1 and MB-2.

1. Quarterly tissue analyses of benthos and fish for heavy metal concentrations.

---

*Current plans for ORNL monitoring include proposed stations on Melton Branch and White Oak Creek for continuous monitoring of pH. The location of the pH stations coincide with the locations suggested for MB-1 and WO-1 in this proposal; subsequent to approval and installation of the pH stations monitoring could be upgraded to include the recommended sampling program.

2. Population studies.

e) surface sediment collection analyses between MB-1 and MB-2.

2. MB-2 (weir): The current monitoring program includes continuous strip chart monitoring of water for pH, D.O., flow, and temperature. Upgrade this program to include the same parameters and sampling frequencies for water quality analyses as for MB-1, in order to determine additive effects of point-source and non-point-source ORNL discharges on Melton Branch.

C. White Oak Lake (WOL, Dam): water quality, sediment and biological analyses to determine additive effects of ORNL effluents on the drainage basin.

a) continuous strip chart recording of D.O., pH, and conductance.

b) continuous proportional samples analyzed for Cr, Zn, Pb, Hg, Cd, NO_3, P, PCB's, Cu, Mn and phenols.

c) daily analyses of BOD, COD, NH_4, suspended solids and residual chlorine based on continuous proportional sampling.

d) biological sampling in WOL (same as for White Oak Creek and Melton Branch).

e) surface sediment sampling and chemical analyses for trace metals in White Oak Lake.

D. Control: Locate a temporary station on Walker Branch Embayment, to serve as a relatively non-polluted control for White Oak Lake, Scarboro Embayment (SE) and Roger's Quarry (RQ). The sampling program would be identical to those described for WOL, SE and RQ, to enable comparison of data.

III. Scarboro Creek - McCoy Branch Drainage Basin

A. Scarboro Embayment: Sampling program should include the following, to determine effects of Kerr Hollow effluents (point source and non-point source) on the biological and chemical environment of Scarboro Embayment, which is accessible for public use.

1. SE-1: (Kerr Hollow): continue current monitoring program and possibly upgrade to increase frequency.

2. SE-2: locate a temporary station at the culvert adjacent to Carbide Park, and include the following:

   a) continuous strip chart recording of D.O., pH and conductance.

   b) continuous proportional sampling for TDS, Zr, suspended solids, Li, Al, Mn, Hg, Zn, U, total N, PO_4, and pesticides.

   c) biological sampling as discussed for other stations.

   d) surface sediment collection and analyses for trace metals as discussed for other stations.

B. Roger's Quarry

1. RQ-1: upgrade current monitoring program to include the following:

   a) continuous strip recorder monitoring for pH, D.O., and specific conductance.

   b) continuous proportional sampling and analyses of water for Cu, Zn, Pb, Hg, Cd and sulfur.

   c) biological sampling

      1. tissue analyses of fish and benthos for heavy metals

      2. population studies of resident and non-resident organisms.

   d) surface sediment collection and analyses as discussed for other stations.

IV. Clinch River

1. Control (water quality): locate temporary station at Oak Ridge sanitary water intake to determine water quality upstream from all Reservation operations. Sampling should include the following:

   a) continuous strip chart recording of pH, D.O. and conductance.

   b) continuous proportional sampling and analyses for Cd, Cs, Cu, CN, Pb, Mn, Hg, Ni, Zn, U, F, TDS, NH_4, suspended solids, SO_4, NO_4, COD, and BOD.

2. CR-1 (Melton Hill Dam): Obtain available data to determine water quality upstream from ORNL outfalls. Continue current monitoring program.

3. Control: Locate temporary station for Clinch River, above Melton Hill Dam (CR-1), to determine river conditions upstream from White Oak Lake discharge sampling should include the following:

   a) biological sampling (see introduction).

      1. tissue analysis of benthos and fish for heavy metals.

      2. population studies of resident and non-resident organisms.

   b) surface sediment analyses for Hg, Cd, Pb, Zn, Cu, Cr, Ni and U.

4. CR-2 (potable H_2O pumping station, ORGDP): No suggested changes. The current monitoring program includes continuous strip chart recording of pH, D.O., and specific conductance, with continuous proportional sampling for Cd, Cs, Cu, CN, Pb, Mn, Hg, Ni, Zn, U, NO_4, SO_4, NH_4, Fl, TDS and suspended solids.

5. CR-3: (RCW pumping station, ORGDP): No suggested changes. The current monitoring program is identical to that conducted at CR-2.

6. CR-4: locate temporary station below last outfall at ORGDP;

   a) sample and analyze water for all compounds included at other stations, using the same methods and frequencies.

   b) biological sampling (as discussed for other stations).

      1. tissue analyses of benthos and fish tissues for trace metals.

      2. quantitative population studies.

   c) surface sediment analyses for trace metals.

Summary of Estimated Cost for
Draft Environmental Statement

	FY 1976	FY 1977
Sampling Program[1]		
ORGDP	128,000	98,000
Y-12	280,000	175,000
ORNL	242,000	198,000
Statement Preparation[2]	86,000	144,000
	736,000	615,000

[1] Sampling program costs are distributed on the basis of the physical relation of the facility to the surface water system under investigation, i.e., ORNL would bear all costs on White Oak drainage basins.

		Thousands
1.	Capital	180
2.	Chemical Analysis	
	Water from existing stations	119
	Water from temporary stations	158
	Sediments and biota	340
3.	Maintenance of stations and sample collection	99
4.	Professional Staff	150
5.	Data Management	75
		1121

[2] Statement preparation costs would be evenly distributed among the three facilities.

APPENDIX 3

ABSTRACT, INTRODUCTION, RECOMMENDATIONS, AND DISTRIBUTION LIST FROM J. W. ELWOOD, "MERCURY CONTAMINATION IN POPLAR CREEK AND THE CLINCH RIVER," JUNE 6, 1977

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
NUCLEAR DIVISION

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ORNL
CENTRAL FILES NUMBER
ORNL/CF-77/320

DATE: June 6, 1977

SUBJECT: Mercury Contamination in Poplar Creek and the Clinch River

TO: C. R. Richmond, Associate Director for Biomedical and Environmental Sciences

FROM: J. W. Elwood, Environmental Sciences Division

CC: Distribution

ABSTRACT

The East Fork of Poplar Creek (EFPC), Poplar Creek (PC), and the Clinch River (CR) below the mouth of Poplar Creek were found to be contaminated with mercury based on analyses and comparisons of Hg concentrations in fish and sediments collected from these environs. Concentrations of total mercury (Σ Hg) in muscle of all largemouth bass collected in Poplar Creek in 1976 exceeded the FDA's proposed action level for Hg in fish of 0.5 ppm, and 95% of the Σ Hg in these fish was in the methyl form. The permitted level of intake by humans of largemouth bass from Poplar Creek containing an average Σ Hg concentration of 0.73 ppm, is calculated to be 40 g/day, based on the FDA recommended maximum intake level of methylmercury. Largemouth bass weighing more than 200 g collected from the Clinch River at the mouth of Poplar Creek also contained Σ Hg concentrations in excess of the FDA's proposed limit and data for this species indicate that Σ Hg levels in the Clinch River are elevated 7 miles below the mouth of Poplar Creek relative to concentrations in largemouth bass from Melton Hill Reservoir. Sediment data show that Bear Creek and East Fork of Poplar Creek are potential sources of the elevated Hg concentrations in Poplar Creek and the Clinch River. Recommendations are given for further defining the sources of Hg contamination in these streams and for examining the mechanisms and rates of Hg transport in the Poplar Creek-Clinch River system.

Introduction

In 1974, fish, benthic invertebrates, and sediments were collected from streams draining the Oak Ridge-ERDA Reservation and analyzed for several heavy metals. This sampling and analysis was conducted to provide information for the environmental impact analysis of Oak Ridge-ERDA Operations. Sediment samples collected at three locations in the East Fork of Poplar Creek (EFPC) contained approximately 25 ± 10 ppm of mercury (± 2 S.E., n = 13), while sediments in Poplar Creek (PC) below the confluence with the East Fork of Poplar Creek contained an average of 14 ± 6 ppm (n = 7) (ERDA 1975a). Two sediment samples from the Clinch River (CR) below the mouth of Poplar Creek at Clinch River Mile (CRM) 11.5 contained 17.3 and 51.9 ppm Hg. Mercury concentrations in sediments from uncontaminated control streams flowing into the East Fork of Poplar Creek contained < 0.1 ppm (ERDA 1975a). These sediment data indicated significant Hg contamination in the East Fork of Poplar Creek, Poplar Creek, and the Clinch River below the mouth of Poplar Creek. Further, muscle from several fish, particularly carp (*Cyprinus carpio*), collected in 1974 from the lower section of Poplar Creek in the vicinity of the Oak Ridge Gaseous Diffusion Plant (K-25) contained elevated levels of total mercury (Σ Hg) (ERDA 1975b), with concentrations in some fish exceeding the Food and Drug Administration's (FDA) proposed action level for mercury in fish of 0.5 ppm (USDHEW 1974). To verify the apparent mercury contamination in the EFPC-PC-CR drainage and to establish the extent of contamination fish from these environs, the Environmental Sciences Division at ORNL was requested by the Oak Ridge-ERDA Operations Office to collect fish from Poplar Creek and the Clinch River and to analyze these samples for mercury. This report contains the results of these analyses and provides comparative data for evaluating the degree of Hg contamination in these environs.

Methods

Fish were collected by electrofishing in May, June, and October 1976. All fish were weighed, measured, and frozen on dry ice. Samples were analyzed for Σ Hg by the Plant Laboratory at Y-12. Axial muscle samples of approximately 5 g were removed from each fish by cutting a rectangular section of the flesh, beginning beneath the dorsal fin and extending ventrally down the side. The skin was removed from all samples. In order to examine intra-laboratory variation in whole analysis of Σ Hg, duplicate muscle samples were removed from the first 60 fish and each duplicate was analyzed separately for Σ Hg. Duplicate samples were removed from every fifth fish thereafter if the fish was sufficiently large to take two 5-g muscle samples. Results for fish weighing < 15 g are based on whole-body analyses (i.e., entire fish, excluding the skin and gastrointestinal tract). Huckabee et al. (1974) reported no difference in Σ Hg concentration between analyses of whole fish and axial muscle in fish samples collected from uncontaminated streams in the Great Smoky Mountains National Park. This finding, however, needs statistical confirmation for fish collected from areas contaminated with mercury.

Recommendations

(1) Studies should be initiated to identify the source(s) and speciation of mercury in the East Fork of Poplar Creek, Bear Creek, Poplar Creek, and the Clinch River by determining the spatial distribution of mercury associated with sediments of selected size fractions and organic content in these environs. It is suggested that mercury associated with surface sediments be mapped in detail in New Hope Pond, the East Fork of Poplar Creek, Bear Creek, and Poplar Creek, above and below the confluence with the East Fork of Poplar Creek, and the Clinch River above and below the mouth of Poplar Creek.

(2) Additional sampling of aquatic food chains (i.e., benthic invertebrates, fish) in the East Fork of Poplar Creek, Poplar Creek, Bear Creek, and the Clinch River should be conducted in order to quantify the baseline levels of Hg contamination in biota in 1977 for comparison with future monitoring data. Fish sampling should be initiated in April in order to collect migrating species such as sauger and white bass which spawn in the Poplar Creek drainage. The sampling should be designed to collect all life history stages (i.e., eggs, fry, fingerlings, and adults of all age groups and sexes) of the species of interest. Analysis for Hg content of components of aquatic food chains in these contaminated environs and in control (uncontaminated areas) should be initiated as soon as possible and conducted on a regular basis (e.g., minimum of annually).

(3) The Quality Control Program for environmental monitoring of mercury (and other heavy metals) should be upgraded. Methods of collection, preparation, and analysis of environmental samples

for Hg should be standardized so that data collected in the various monitoring programs at X-10, Y-12, and K-25 are comparable. For sediment samples, it is recommended that the procedure for sampling surface sediments be carefully defined and standardized and the < 63-μ size fraction (i.e., sediment particles that pass through a U.S. Standard 250-mesh sieve or a 230 Tyler Standard Sieve) be analyzed. Total mercury in the two size fractions (i.e., > 63 and < 63 μ) and in bulk sediments should be analyzed in select samples in order to check recoveries and to determine the distribution of mercury as a function of particle size. Sediment samples should be wet sieved (using filtered water from the site where the sample was collected) as soon as possible after collection (and prior to freezing), dried at < 60°C, and quantitatively analyzed for Hg using flameless AAS. The dissolution method of sediment samples should follow the procedure recommended by the Environmental Protection Agency (see "Mercury in Sediments" on p. 134 of USEPA 1974). Quality control samples, including "blind" reference standards for water, sediments, and biological materials, should be exchanged by all monitoring laboratories on a regular basis.

(4) Procedures for monitoring mercury in liquid effluents and surface waters should be modified so that both total and particulate mercury are measured. Dissolved mercury can then be determined by the difference. In addition, analysis should be done on grab samples collected under various flow regimes rather than on composite samples held over a week. Water samples should be collected in glass containers and acidified immediately after collection with concentrated Ultrex nitric acid. Holding times prior to analysis for mercury

samples should be kept to a minimum, preferably < 12 hr. For particulate Hg, aliquots should be filtered immediately on collection through a membrane filter (Nuclepore membrane filters are recommended because of their uniform pore size, low Hg background, and low sorption of Hg by filter material) with a 0.4-μ pore size before adding the acid. For total Hg, the filtration is omitted, and the sample should be collected directly in a pre-acidified, baked glass volumetric container.

(5) Because of the agricultural utilization of the East Fork of Poplar Creek and its floodplain and the potential for deposition for Hg-contaminated sediments on the floodplain during high discharges, it is recommended that soils and vegetation along the East Fork of Poplar Creek be sampled and analyzed for Σ Hg.

~~Acknowledgements~~

~~I wish to acknowledge the contributions of John J. Beauchamp (Computer Sciences Division) for his help in the statistical analyses of the data presented herein; to Joe Gooch, Mack Stubbs, Dave Carroll, and Robert Stark (Environmental Sciences Division), and Michael Ellis (K-25) for their help in collecting the fish; to Mike Mitchell for providing the sediment data for Poplar Creek; to Roy Morrow and Ruby Viator (Plant Laboratory at Y-12) for analyzing the fish samples for Hg and to Ralph Turner, Steve Lindberg, and Steve Hildebrand (ESD) for their technical review of this report. The interest, cooperation, and contribution of all the above individuals is appreciated.~~

DISTRIBITION

1. S. I. Auerbach, ESD, ORNL
2. J. M. Case, UCCND, Y-12
3-4. J. W. Elwood, ESD, ORNL
5. H. D. Fletcher, ERDA-ORO
6. H. D. Hickman, ERDA-ORO
7. R. G. Jordan, UCCND, Y-12
8. E. M. King, UCCND, X-10
9. J. A. Lenhard, ERDA-ORO
10. H. Postma, UCCND, X-10
11-15. C. R. Richmond, UCCND, X-10
16. M. Sanders, UCCND, Y-12
17. S. S. Stief, UCCND, ORGDP
18. J. F. Wing, ERDA-ORO
19. R. A. Winkel, UCCND, X-10
20. Laboratory Records Department, RC
21. Laboratory Records Department

APPENDIX 4

MEMORANDA RELATING TO THE ELWOOD (1977) REPORT

From M. Sanders to J. D. McLendon, dated August 6, 1970
From S. I. Auerbach to C. R. Richmond, dated March 22, 1977
From C. R. Richmond to J. F. Wing, dated March 22, 1977
From C. R. Richmond to Distribution, dated June 13, 1977
From S. I. Auerbach to C. R. Richmond, dated September 9, 1977
From C. R. Richmond to R. G. Jordan, dated October 26, 1977

UNION CARBIDE

INTERNAL CORRESPONDENCE

NUCLEAR DIVISION

POST OFFICE BOX Y, OAK RIDGE, TENNESSEE 37830

To (Name) J. D. McLendon

Division

Location Building 9711-1

Copy to File

Date August 6, 1970

Originating Dept. Radiation Safety - 2373

Answering letter date

Subject Mercury Analysis

The attached gives a listing of recent analysis for Mercury content in fish, water, and mud samples collected in the Oak Ridge area. The limit suggested by U.S.P.H. for Mercury content in fish is 0.5 ppm.

Merwyn Sanders

MS:ep
Attachment

FISH ANALYSIS

LOCATION	SPECIES	ppm MERCURY
Discharge of New Hope Pond	Carp	.32
Pond East Fork Poplar Creek	Carp	.57
	Blue-Gill	1.0
	"	1.0
	"	.73
	"	.41
	"	.49
	"	.65
	"	.71
	"	1.30
	"	.67
	"	.65
Bear Creek	Carp	.09
Proposed Monitoring	Carp	.09
Station	Blue-Gill	.03
	"	< .005
	"	.10
	Cray-Fish	.11
		.16
		.78
		.22
Fresh Fish from Market	Sea Squab	.05
	Cat Fish (Y-12 Cafeteria)	.027
	Mackerel (Y-12 Cafeteria)	.29
	King Mackerel	.67
	Strip Bass	.086
	Red Snapper	.38
	Sole Fish	.05

WATER ANALYSIS

LOCATION	ppm MERCURY
New Hope Pond East Fork Poplar Creek	.00026
New Hope Pond East Fork Poplar Creek	.0005
East Fork Poplar Creek 200 Yards Downstream of New Hope Pond	.0002
East Fork Poplar Creek at Wiltshire Estate	< .0002
East Fork Poplar Creek at Oak Ridge Country Club	< .0002
Melton Hill Lake at Oak Ridge Marina	< .0002
Bear Creek 1 Mile West of Y-12 Disposal Area	< .0002
Bear Creek at Proposed Sampling Station	< .0002
Bear Creek at TVA Gaging Station #25	< .0002
Bear Creek Spring No. 4	< .0002
Bear Creek Geological Test Well Ch-1	< .0002
Bear Creek Geological Test Well Co-1	< .0002

MUD ANALYSIS

LOCATION	ppm MERCURY
New Hope Pond - East Fork Poplar Creek	63
East Fork Poplar Creek - 200 yards below Pond	.90
East Fork Poplar Creek - Wiltshire Estate	1.6
East Fork Poplar Creek - Oak Ridge Country Club	11.3
Melton Hill Lake at Oak Ridge Marina	.01
Bear Creek at Proposed Sampling Station	.17
Bear Creek at Spring #4	.04
Bear Creek at TVA Gaging Station #25	.13
Bear Creek Geological Test Well Ch-1	.19
Bear Creek Geological Test Well Co-1	.23

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

March 22, 1977

To: C. R. Richmond, Associate Director of Biomedical and Environmental Research

From: S. I. Auerbach, Director, Environmental Sciences Division

Subject: BUSINESS CONFIDENTIAL Report on Mercury Contamination in the Poplar Creek-Clinch River Drainage

Attached for your review and distribution to individuals responsible for environmental safety and monitoring at the Oak Ridge-ERDA facilities are six copies of the BUSINESS CONFIDENTIAL report prepared by Jerry W. Elwood of the Environmental Sciences Division concerning mercury contamination in Poplar Creek-Clinch River drainage. The report contains an analysis of the data on mercury in fish and sediments collected in the drainage in 1976, and summarizes the available data on mercury in streams and reservoirs in this area. The literature on mercury in aquatic environments was also reviewed in order to provide readers with some perspective on the extent of mercury contamination in these environs. Several recommendations are made for studies to identify the source of the mercury, to determine the extent of the contamination, and to determine the current mercury discharges to surface waters from Oak Ridge-ERDA facilities.

Also attached for your approval and signature is the draft of a cover memorandum which you requested be prepared for distribution with the report. The distribution list on the cover memorandum was suggested by J. F. Wing, ORO-ERDA. The BUSINESS CONFIDENTIAL category was used, also at J. F. Wing's suggestion, to limit distribution of the report.

It is my understanding that when comments on the report have been received, a final BUSINESS CONFIDENTIAL report is to be prepared in the Environmental Sciences Division and distributed by you to the following individuals as well as to Laboratory Management:

S. I. Auerbach - ESD, ORNL
H. D. Fletcher - ERDA-ORO, Uranium Enrichment Operations Division
H. D. Hickman - ERDA-ORO, Manufacturing Division
R. G. Jordon - UCCND, Y-12
E. M. King - UCCND, X-10
J. A. Lenhard - ERDA-ORO, Research and Technical Support Division
J. L. Liverman - ERDA Headquarters, DBER, Washington, D. C.
M. Sanders - UCCND, Y-12
S. S. Stief - UCCND, ORGDP
J. F. Wing - ERDA-ORO, Safety and Environmental Control Division
J. W. Elwood - ESD, ORNL

SIA:jmd
Enclosures 7

Distribution by S. I. Auerbach ______ Cy. fwd.: ~~J. W. Elwood~~
3/24/77, SIA

Brocksen ______ Parzyck ______
Burgess ______ Reichle ______
Coutant ______ Struxness ______
______ ______
Duguid ______ Yann ______
Gehrs ______ ______
Harris ______
Kaye ______
______

UNION CARBIDE

INTERNAL CORRESPONDENCE

NUCLEAR DIVISION

~~POST OFFICE~~ BOX X, OAK RIDGE, TENNESSEE

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______ Responsible

To (Name) Distribution

Division

Location

Date March 22, 1977

Originating Dept.

Answering letter date

RECEIVED ESD-
MAR 77 3: 16

Copy to J. F. Wing, ERDA, ORO

Subject BUSINESS CONFIDENTIAL Report on Mercury Contamination in Poplar Creek and Clinch River

In accordance with arrangements made at a meeting in R. G. Jordan's office at Y-12 on December 20, 1976, the attached BUSINESS CONFIDENTIAL report on mercury contamination in sediments and fish in the Poplar Creek-Clinch River drainage is being distributed to you for review and comment. This report contains an analysis of the data on mercury in fish and sediments collected in this drainage in 1976 and summarizes the available information on mercury in streams and reservoirs in this area. In addition, the literature on mercury in aquatic environments is reviewed in order to provide you with some perspective on the extent of mercury contamination in the Poplar Creek drainage. While the source(s) of the elevated mercury levels in fish and sediments observed in portions of the drainage could not be defined from available information, the data suggest several potential sources. Recommendations are made in the report for specific studies to identify the source(s) of mercury contamination as well as to define the extent of the environmental contamination downstream from ERDA facilities at K-25 and Y-12. Recommendations also are made to modify some of the liquid effluent monitoring practices at these facilities in order to more accurately quantify mercury discharges to surface waters.

After you have reviewed this report, please transmit your written comments by April 8, 1977, to Jerry Elwood, ORNL, Building 2001, X-10, telephone extension 3-1410. A final report will then be prepared and distributed to you.

C. R. Richmond

C. R. Richmond

Enclosure

Distribution: R. G. Jordan, UCCND, Y-12
E. M. King, UCCND, X-10
M. Sanders, UCCND, Y-12
S. S. Stief, UCCND, ORGDP

bc: S. I. Auerbach

BUSINESS CONFIDENTIAL

UNION CARBIDE **INTERNAL CORRESPONDENCE**

NUCLEAR DIVISION

POST OFFICE BOX X, OAK RIDGE, TENNESSEE 37830

To (Name) Distribution

Division

Location

Date June 13, 1977

Originating Dept. C. R. Richmond

Answering letter date

Copy to H. D. Fletcher, ERDA-ORO
H. D. Hickman, ERDA-ORO
J. A. Lenhard, ERDA-ORO
J. F. Wing, ERDA-ORO

Subject Mercury contamination in Poplar Creek and Clinch River sediments

Under separate cover you will soon receive a copy of a report entitled "Mercury Contamination in Poplar Creek and the Clinch River" (ORNL/CF-77/320). This report, prepared by J. W. Elwood of the Environmental Sciences Division at ORNL, contains an analysis of the data on mercury in fish and sediments in the East Fork of Poplar Creek, Bear Creek, Poplar Creek, and the Clinch River. Some fish and/or sediment samples from all of these waters were found to contain mercury levels in excess of the background concentrations in streams and reservoirs in this area. The literature on mercury in aquatic environments was reviewed in order to provide you with some perspective on the extent of mercury contamination in these environs.

During the review of existing data, some problems with the procedures used for the analysis and monitoring of mercury at Y-12 and ORGDP were found. Accordingly, recommendations have been made in the report to modify these procedures. Recommendations have also been made to initiate studies to identify the source(s) of mercury contamination and to better define the extent of the contamination in fish and sediments downstream of ERDA facilities at Y-12 and ORGDP. It is my understanding that some of the recommendations in the report have already been implemented.

The report shows that some fish in Poplar Creek and in the Clinch River at the mouth of Poplar Creek contain mercury concentrations in excess of the proposed action level for mercury established by the

U.S. Food and Drug Administration. Since these are public waters which are accessible to and utilized by sport fishermen, it is important that the sources and extent of this mercury contamination be defined so that, if necessary, appropriate counter measures can be taken.

C R Richmond

C. R. Richmond

CRR:JWE:lwl

Enclosure

Distribution: S. I. Auerbach, UCCND, X-10
J. M. Case, UCCND, Y-12
J. W. Elwood, UCCND, X-10
R. G. Jordon, UCCND, Y-12
E. M. King, UCCND, X-10
H. Postma, UCCND, X-10
M. Sanders, UCCND, Y-12
S. S. Stief, UCCND, ORGDP
R. A. Winkel, UCCND, ORGDP

cc: J. W. Elwood
L. D. Eyman
S. G. Hildebrand

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

September 9, 1977

To: C. R. Richmond, Associate Director, Biomedical and Environmental Sciences

From: S. I. Auerbach, Director, Environmental Sciences Division

Subject: Monitoring Data and Reports for Oak Ridge-ERDA Facilities

In the past year, staff members in the Environmental Sciences Division have reviewed some of the aquatic-monitoring data and monitoring reports prepared by UCC-ND for the Oak Ridge-ERDA facilities. These reviews were prompted, in part, by the need for information on mercury levels in the local environs, including Poplar Creek and Clinch River. In addition, we felt it necessary to review the available physical-chemical monitoring data prior to designing and implementing a biological sampling program to assess the impacts resulting from operation of the Oak Ridge Gaseous Diffusion Plant. During the course of these reviews, several questions were raised concerning the objectives of environmental monitoring at the ERDA facilities, the method of summarizing and reporting data, and requirements for interpretation of monitoring data. Results of trace metal analysis for Poplar Creek sediments provide several examples which illustrate specific questions that were raised.

In both the 1975 and the 1976 Monitoring Report for Oak Ridge-ERDA facilities (Y/UB-4 and Y/UB-6), concentrations of selected trace metals in Poplar Creek sediments were reported (Tables 25 and 28, respectively). The conclusion in the 1975 report is that "Insufficient comparative data precludes any quantitative analysis of this current sediment sample data," but that .... "Future plans include collection of additional samples from the upper west fork of Poplar Creek to determine background levels." The sediment sampling program in Poplar Creek was expanded in 1976, presumably to obtain additional comparative data, including background levels in streams not receiving effluents from ERDA facilities. The conclusion in the 1976 report, which contains results of the expanded program, however, is that "Evaluation of the ORGDP impact on sediment concentrations is complicated by the fact that Poplar Creek at ORGDP is, during much of the year, a part of Watts Bar Reservoir and thus, along that portion of the stream, simulates a settling basin for both Poplar Creek and East Fork Poplar Creek. A meaningful interpretation of the data cannot currently be made due to the relatively short time period over which the data have been collected." The fact that the lower section of Poplar Creek acts as a settling basin for suspended sediments in East Fork Poplar Creek and Poplar Creek has been known since Watts Bar Reservoir was formed. If the objective of the sediment sampling program is to determine the role of ORGDP on metal concentrations, the monitoring program must obviously be designed to account for metals in both East Fork Poplar Creek and Poplar Creek sediments. It would seem that a program to accomplish this objective could have been designed when sediment monitoring was initiated and certainly modified to meet the objective after two years of data collection. It is our understanding, however, that sediment sampling still does not include stations in the East Fork Poplar Creek. Therefore, isolating the impact of ORGDP on metal concentrations in Poplar Creek and Clinch River sediments seems unlikely until stations on East Fork Poplar Creek are established and monitored regularly.

The manner in which sediment data are summarized in the reports raises questions about the validity of comparing sampling locations and dates. There is no indication of sample numbers or variation in mean concentrations within sampling locations. Are the differences in concentrations between stations statistically significant?

Analysis of the frequency distribution of mercury levels in Poplar Creek sediments (PCM 0 to PCM 5.2) shows that mercury concentrations in 1975 and 1976 do not follow a normal or a log-normal distribution in either year. Concentrations in 1975 follow a bimodal distribution, while in 1976 the distribution is not bimodal but is definitely skewed. The expected frequencies of mercury concentrations for the Chi square (χ^2) statistic were calculated from the observed frequencies in 1975 and 1976. The results of the test showed that the frequency distribution of mercury in Poplar Creek sediment in 1975 and 1976 were significantly different from each other. It is interesting to note that the observed frequency in the smallest concentration class (< 0.1 ppm of Hg) decreased from 1975 to 1976, while the observed frequency in the middle and largest classes (0.10 to 10 and > 10 ppm, respectively) increased, suggesting that mercury levels in Poplar Creek sediments may have increased from 1975 to 1976. The important point, however, is that since neither the 1975 nor 1976 data follow a normal distribution, the data must be transformed before comparing concentrations between sampling locations and dates. There is no indication in the monitoring reports as to how the mean concentrations of metals in sediments were calculated and what assumptions are made about the frequency distribution of the observed concentrations. Also, if Poplar Creek in the vicinity of ORGDP is a settling basin for suspended sediments, what is the basis for the 15 sampling stations in Poplar Creek and why are the station locations either not shown on a map or described?

The method of sediment analysis is incorrectly stated to be atomic absorption (page 16 of the 1976 report); whereas, according to J. C. White, an emission spectrograph (which has a substantially lower precision) was used for analysis of mercury and presumably all other metals. It is our understanding that mercury is now being analyzed by atomic absorption but sediment mercury concentrations in 1975 and 1976 were determined by emission spectrometry.

A question was also raised about the absence of biological monitoring in aquatic environments. The 1972 Federal Water Pollution Control Act Amendments (Public Law 92-500) specifically requires that wherever appropriate each discharger conduct biological monitoring in receiving waters. The Act is very explicit and detailed in its requirements (Sections 308 and 504) that effects of pollutants be measured on aquatic life actually in receiving waters (not in laboratory aquaria) and monitoring be conducted to detect accumulation of pollutants in tissue of organisms representative of appropriate levels of the food chain. Such biological monitoring data would be helpful to our staff in making their assessment of the environmental impacts resulting from operation of the Oak Ridge Gaseous Diffusion Plant.

In summary, the consensus of the staff members reviewing the monitoring reports was that aquatic monitoring of physical-chemical parameters was, in general, poorly designed to define the effects of specific facilities on contaminant levels and to quantify changes in contaminant levels over time. In addition, there is too little attention given to statistical analysis of existing physical-chemical data and data interpretation. It is our experience that for monitoring programs to be effective in terms of costs and information, they must be designed with specific objectives in mind. Because a primary objective of monitoring is to define the environmental impacts of each facility, it is imperative that both the biotic and abiotic components be monitored. The absence of regular biological monitoring precludes the possibility of defining the effects of contaminants on biological populations in the receiving waters. Since we must rely on public documents which can be cited in our environmental assessment of ORGDP, these monitoring reports provide an important data source. We would, therefore, like to ensure that these reports provide comprehensive and reliable environmental data for use in the assessment.

Because of our concerns over the status of monitoring in the Poplar Creek-Clinch River drainage, we recommend that the current physical-chemical monitoring program for aquatic environments be evaluated with emphasis on the specific objectives and requirements of monitoring, selection of monitoring stations and parameters, and analysis and reporting of monitoring data. We also recommend that a routine biological monitoring program be incorporated in the program. Members of the Environmental Sciences Division are available to participate in an evaluation of the current monitoring program and to assist in the design and implementation of biological monitoring. I look forward to discussing these matters with you at your convenience.

SIA:jmd
cc: F. R. Bruce
W. Fulkerson

Copies fwd. for immediate attenti
~~E. G.~~ Struxness (get ready for meeting..)
D. E. Reichle
~~10/27/77, SIA~~

UNION CARBIDE

INTERNAL CORRESPONDENCE

OCT 27 1977

NUCLEAR DIVISION

POST OFFICE BOX X, OAK RIDGE, TENNESSEE 3783

To (Name) R. G. Jordan

Date October 26, 1977

Division

Location 9704-2

Originating Dept.

Answering letter date

Copy to S. I. Auerbach
R. F. Hibbs
H. Postma

Subject Monitoring Data and Reports for Oak Ridge-DOE Facilities

RECEIVED ESD-

7 OCT 77 11: 2

Stan Auerbach has expressed interest in and concern about monitoring data and reports for Oak Ridge-DOE facilities. They are particularly concerned about the lack of sediment sampling for metals in East Fork Poplar Creek. They are also concerned about the way sediment data from other locations are summarized in reports such as Y/UB-4 (1975) and Y/UB-6 (1976). Because no indication of sample numbers or variation in mean concentrations within sampling locations is given, it is difficult to determine statistical significance between concentration values found at different sampling stations.

According to Auerbach's staff, the data analysis for mercury levels in Poplar Creek might be complicated because of different distribution functions, neither of which appear to be normal for samples obtained in 1975 and 1976. They have questions concerning sampling station locations in Poplar Creek (they are not given in the reports) and method of analysis for sediment samples (atomic absorption or emission spectrograph).

There is also some concern in the Environmental Sciences Division (ESD) about our compliance with Sections 308 and 504 of the 1972 Federal Water Pollution Control Act Amendments (PL-92-500) that require biological monitoring in aquatic environments. ESD relies on public documents such as the monitoring reports noted above as input to their assessment of ORGDP. Because of this, they would like to provide any expertise they currently have in assisting you and your staff in making these monitoring reports more valuable.

I would like to suggest that you or your staff might meet with Auerbach and his staff to determine if their perceptions and concerns are justified and to decide whether they can be of assistance in evaluating the current aquatic monitoring program (selection of monitoring stations and parameters, sampling, analyses of samples, data analyses, and reporting) and also in the design and implementation of biological monitoring efforts.

C. R. Richmond

C. R. Richmond

CRR:br

APPENDIX 5

MATERIAL RELATING TO THE ECOLOGICAL STUDIES FOR THE ENVIRONMENTAL ANALYSES OF THE ORGDP AND ORNL FACILITIES

Memorandum from S. I. Auerbach to J. F. Wing, dated January 21, 1977.

Title Page and Table of Contents from "Environmental Assessment of the Oak Ridge Gaseous Diffusion Plant Site," DOE/EA-0106, U.S. Department of Energy, Oak Ridge, Tennessee, December 1979.

Title Pages, Table of Contents, and Distribution List from Loar (ed.), "Ecological Studies of the Biotic Communities in the Vicinity of the Oak Ridge Gaseous Diffusion Plant," ORNL/TM-6714. Oak Ridge National Laboratory, Oak Ridge, Tennessee, October 1981

Memorandum from S. I. Auerbach to J. F. Wing, dated March 30, 1977.

Title Page, Table of Contents, and Distribution List from Loar et al., "Technical Background Information for the ORNL Environmental and Safety Report, Volume 2; A description of the Aquatic Ecology of White Oak Creek Watershed and the Clinch River below Melton Hill Dam," ORNL/TM-7509/V2. Oak Ridge National Laboratory, Oak Ridge, Tennessee, October 1981.

Title Page, Table of Contents, and Distribution List from Boyle et al., "Environmental Analysis of the Operation of Oak Ridge National Laboratory (X-10 Site)," ORNL-5870. Oak Ridge National Laboratory, Oak Ridge, Tennessee, November 1982.

OAK RIDGE NATIONAL LABORATORY

OPERATED BY

UNION CARBIDE CORPORATION

NUCLEAR DIVISION

POST OFFICE BOX X

OAK RIDGE, TENNESSEE 37830

January 21, 1977

Mr. J. F. Wing
Chief, Environmental
Protection Branch
U.S. Energy Research and
Development Administration
Oak Ridge Operations
Oak Ridge, TN 37830

Dear Jerry:

Enclosed find the Environmental Sciences Division draft proposal to undertake a comprehensive biological monitoring program in the ORGDP aquatic and terrestrial environs. These studies are projected to involve a full year of sampling beginning in late February, 1977. The results of this work will provide biological data necessary for the promulgation of a defensible environmental impact statement related to the ORGDP operations.

The total budget will be $275,000 and will take the efforts of four full-time ESD employees (one professional, three technical). The work will be administered by the aquatic and terrestrial ecology Section Heads, R. W. Brocksen and W. F. Harris, respectively.

I appreciate your help and concern in this matter and look forward to an expeditious facilitation of the program.

Sincerely,

S. I. Auerbach, Director
Environmental Sciences Division

SIA:cgg

Enclosure

cc: W. Fulkerson (w/note attached)
D. E. Reichle
C. R. Richmond
E. G. Struxness

TITLE: Non-Radiological Aquatic and Terrestrial Biological Monitoring Program for the Oak Ridge Gaseous Diffusion Plant

PRINCIPAL INVESTIGATORS: R. W. Brocksen and W. F. Harris
Environmental Sciences Division
Oak Ridge National Laboratory

INTRODUCTION AND SCOPE:

The Preliminary Draft Environmental Analysis of the Oak Ridge-ERDA Operations provided the justification and need for the implementation of a systematic biological monitoring program in aquatic and terrestrial environments in the vicinity of the Oak Ridge Gaseous Diffusion Plant. A comprehensive environmental and effluent sampling program for physical and chemical parameters has been developed and implemented by the staff of the ORGDP. This proposal details a biological monitoring program that can be coordinated with the existing physical and chemical monitoring program for the ORGDP. The results of these monitoring programs will provide the environmental data necessary to prepare an Environmental Impact Statement for the ORGDP.

The major component of the proposed biological monitoring will be directed toward a systematic characterization and quantification of aquatic communities at select stations on Poplar Creek and the Clinch River both upstream and downstream of ORGDP liquid effluents. In addition to this effort, we will determine the extent of accumulation in resident aquatic biota of selected elements identified in liquid effluents from ORGDP. We also propose to implement a sampling scheme which will quantify the extent of accumulation of fluorides and nickel in naturally occurring plant and mammal communities in the terrestrial environment of ORGPD.

Aquatic Sampling Stations

Station Number 1 - Poplar Creek upstream from the confluence with East Fork Poplar Creek and above the tidal influence caused by fluctuations in water level in Watts Bar Reservoir.

Station Number 2 - Poplar Creek between the confluence of East Fork Poplar Creek and Blair Bridge.

Station Number 3 - Poplar Creek downstream from last identified effluent release point of the K-25 facility.

Station Number 4 - Clinch River approximate river mile 18 upstream from confluence with Poplar Creek.

Station Number 5 - Clinch River approximate river mile 11.5 above the K901A holding pond.

Station Number 6 - Clinch River approximate river mile 10.5 below confluence with Poplar Creek and the K901A holding pond.

These stations are consistent with those currently sampled by the staff of ORGDP for physical and chemical parameters.

Biological Compartments of Aquatic Systems to be Sampled for Population and Community Analysis and Sampling Frequency

1. Periphyton, phytoplankton and zooplankton - Stations 1-6, bimonthly for one year.
2. Benthic invertebrates - stations 1-6, bimonthly for one year.

3. Fish - Stations 1-6, bimonthly for one year with more intensive effort in Poplar Creek during spawning migrations.
4. Ichthyoplankton - Stations 2-3, major sampling in the spring.

Tissue Analysis of Aquatic Biota

Twice during the year we will analyze 5-10 fish each of three species from stations 1-6 for Hg, Cd, Pb, Zn, Cu, Cr, Ni, and U. Coincident with the fish tissue analyses, we will analyse samples of benthic invertebrates from station 1-6 for the same elements. The number of samples will depend on the availability of benthic invertebrate biomass.

Sampling of Terrestrial Ecosystem Compartments for Fluorides and Nickel

We propose to establish three 10,000 meter sampling transects running SW-NE with the center of ORGDP as the transect mid-point. Live trapping grids for small mammals will be located at 750 m, 1000 m, 2000 m, and 5000 m on each transect. Samples of vegetation will also be collected on the trapping grids. Larger mammals will be collected at select stations. Mammals and vegetation will be collected during the following periods: February-March, May-June, August-September, and November-December. Vegetation and mammals will be analyzed for fluorine and nickel. Vegetation will be examined for evidence of fluorine damage. Two control areas will be sampled for the same parameters. The control areas will be in the general vicinity of Gallahar Bend and Park City Bend.

BUDGET

FY 77		FY 78	
3 MY	141 K	1 MY	52 K

1 professional level aquatic ecologist.

2 technical level aquatic biologists.

1 technical level terrestrial biologist.

Analytical - 72 K

Equipment and Supplies 10 K

DOE/EA-0106
Distribution Category UC-22

ENVIRONMENTAL ASSESSMENT OF THE OAK RIDGE GASEOUS DIFFUSION PLANT SITE

Oak Ridge, Tennessee

DECEMBER 1979

prepared for the
DEPARTMENT OF ENERGY

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ORNL/TM-6714

Contract No. W-7405-eng-26

ECOLOGICAL STUDIES OF THE BIOTIC COMMUNITIES IN THE VICINITY OF THE OAK RIDGE GASEOUS DIFFUSION PLANT[1]

EDITOR

J. M. Loar

CONTRIBUTORS

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G. F. Cada
J. W. Huckabee[3]
J. T. Kitchings
K. D. Kumar
J. M. Loar
A. M. Sasson[4]
J. A. Solomon
J. D. Story

ENVIRONMENTAL SCIENCES DIVISION

Publication No. 1744

---

[1]Prepared for U.S. Department of Energy, Oak Ridge Operations Office.
[2]Present address: 11811 Pleasantree, Little Rock, Arkansas 72211.
[3]Present address: Electric Power Research Institute, P.O. Box 10412, Palo Alto, California 94303.
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Date Published: October 1981

Prepared by the
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
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DEPARTMENT OF ENERGY

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56. Donald Owens, Division of Water Quality Control, Tennessee Department of Public Health, 1522 Cherokee Trail, Knoxville, TN 37920
57. Henry B. Piper, Licensing Chief, Clinch River Breeder Reactor Project, P.O. Box U, Oak Ridge, TN 37830
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POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37830

October 20, 1981

Mr. David Bishop
Tennessee Wildlife Resources Agency
1929 W. Morris Blvd.
Morristown, TN 27814

Dear Mr. Bishop:

Enclosed please find a copy of ORNL/TM-6714. Your name was inadvertently omitted from the External Distribution List for this report.

Sincerely,

JM Loar

James M. Loar
Environmental Sciences Division

JML:csa

OAK RIDGE NATIONAL LABORATORY
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POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37830

October 20, 1981

Mr. Ralph H. Brooks, Chief
Water Quality and Ecology Branch
Tennessee Valley Authority
248 401 Building
Chattanooga, TN 37401

Dear Mr. Brooks:

Enclosed please find a copy of ORNL/TM-6714. Your name was inadvertently omitted from the External Distribution List for this report.

Sincerely,

JMLoar

James M. Loar
Environmental Sciences Division

JML:csa

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OAK RIDGE, TENNESSEE 37830

March 30, 1977

Mr. J. F. Wing
Chief, Environmental
Protection Branch
U.S. Energy Research and
Development Administration
Oak Ridge Operations
Oak Ridge, TN 37830

Dear Jerry:

Attached find the Environmental Sciences Division draft proposal to undertake a comprehensive biological monitoring program in the ORNL aquatic and terrestrial environs. These studies are projected to involve a full year of sampling beginning in early April, 1978. The results of this effort will provide the data necessary for the generation of a defensible environmental impact statement related to ORNL operations.

As you will see in reviewing this draft, two budgets are proposed. The first is appropriate for biological sampling and analyses only and is $420,000. The second encompasses the biological as well as the sediment and water quality sampling programs and is $770,000. Until such time as classification of responsibility is made, I must assume our obligations to include all three elements and the required budget to be $770,000.

The work will be administered by the aquatic and terrestrial ecology sections heads, R. W. Brocksen and W. F. Harris, respectively.

Thank you for your attention to this matter and I look forward to your response.

Sincerely,

S. I. Auerbach, Director
Environmental Sciences Division

SIA:cgg

Enclosure

cc: W. Fulkerson — C. R. Richmond
D. E. Reichle — E. G. Struxness

TITLE: Non-Radiological Aquatic and Terrestrial Biological Monitoring Program for the Oak Ridge National Laboratory

PRINCIPAL INVESTIGATORS: R. W. Brocksen and W. F. Harris
Environmental Sciences Division
Oak Ridge National Laboratory

INTRODUCTION AND SCOPE:

The Preliminary Draft Environmental Analysis of the Oak Ridge-ERDA Operations provided the justification and need for the implementation of a systematic biological monitoring program in aquatic and terrestrial environments in the vicinity of the Oak Ridge National Laboratory. This proposal details a biological monitoring program which is directed toward a systematic characterization and quantification of aquatic and terrestrial communities at select stations above and below the ORNL facilities on White Oak Creek and Melton Branch and the Clinch River above and below the confluence of White Oak Creek. In addition to this effort we will determine the extent of accumulation in resident aquatic and terrestrial biota of various radiological and non-radiological contaminants which were selected on the basis of both known releases from the facilities and levels analyzed during the environmental sampling program for the Preliminary Draft Environmental Analysis of the Oak Ridge-ERDA Operations. The radiological analysis of fish and benthic invertebrates will be conducted by the Health Physics Division under separate funding.

A more comprehensive environmental and effluent sampling program for physical and chemical parameters should be conducted concurrently with the proposed biological monitoring program. Collection of the data on water quality and sediments can be coordinated with the existing environmental surveillance program and the proposed biological monitoring program. The results of these monitoring programs will provide the environmental data necessary to prepare an Environmental Impact Statement for ORNL.

Aquatic Sampling Stations

Station # 1: White Oak Creek above the 7000 Area.

Station # 2: White Oak Creek between Weir No. 3 and Melton Valley Drive bridge.

Station # 3: Melton Branch above Weir No. 4.

Station # 4: White Oak Creek between the confluence with Melton Branch and White Oak Lake.

Station # 5: White Oak Lake.

Station # 6: White Oak Creek between White Oak Lake and the confluence with the Clinch River.

Station # 7: Melton Hill Lake in the vicinity of the EGCR (river mile 32).

Station # 8: Clinch River between Melton Hill Dam and Rt. 95 bridge.

Station # 9: Clinch River between river mile 20.5 and river 21.5.

Station #10: Clinch River at river mile 18.

These stations are consistent with those currently sampled by the Health Physics Division and the Operations Division for radiological and non-radiological contaminants.

Biological Compartments of Aquatic Systems to be Sampled for Population and Community Analysis and Sampling Frequency

1. Phytoplankton and zooplankton: Stations 4-6 and 8-10, bimonthly for one year.
2. Periphyton: Stations 1-6 and 8-10, bimonthly for one year.
3. Benthic invertebrates: Stations 1-6 and 8-10, bimonthly for one year.
4. Fish: Stations 1-6 and 8-10, bimonthly for one year.
5. Ichthyoplankton: Stations 4-6, major sampling in the spring.

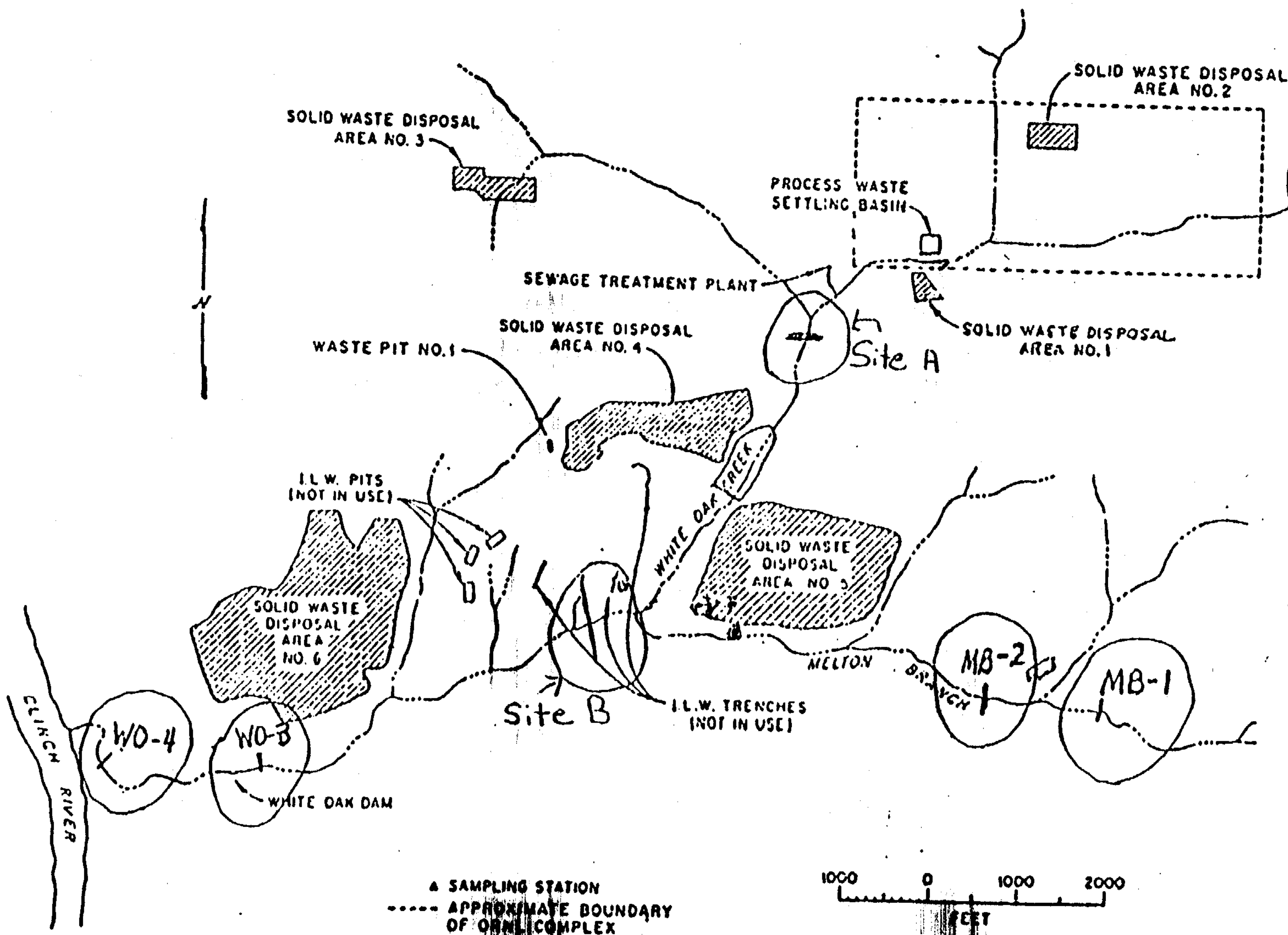
Tissue Analysis of Aquatic Biota

Twice during the year we will analyze 5-10 fish each of three species from stations 1-10 for Hg, Cd, Pb, Zn, Cu, Cr, Ni, U, and PCB's. Coincident with the fish tissue analyses, we will analyze samples of benthic invertebrates from stations 1-10 for the same elements. The number of samples will depend on the availability of benthic invertebrate biomass.

Sampling of Terrestrial Ecosystem Compartments for Lead, Mercury and Zinc

We propose to determine the transfer of lead, mercury and zinc from White Oak Creek and Melton Creek to adjacent terrestrial communities. Concomitantly, the influence of these elements on the function and structure of these communities will be determined. Seven 300 meter x 900 meter grid sites covering both creeks will be used is compling sites. From these sites, soil, litter, vegetation, invertebrates and vertebrates will be collected seasonally. Mammal trapping transects will be established within each site. Sample sites are shown on the attached map:

Site 1. WO-1
2. MB-1
3. MB-2
4. Site A
5. Site B
6. WO-3
7. WO-4


SOLID WASTE DISPOSAL AREA NO. 2
SOLID WASTE DISPOSAL AREA NO. 3
PROCESS WASTE SETTLING BASIN
WO-1
SEWAGE TREATMENT PLANT
SOLID WASTE DISPOSAL AREA NO. 1
Site A
WASTE PIT NO. 1
SOLID WASTE DISPOSAL AREA NO. 4
N
I.L.W. PITS (NOT IN USE)
WHITE OAK CREEK
SOLID WASTE DISPOSAL AREA NO. 5
SOLID WASTE DISPOSAL AREA NO. 6
MELTON BRANCH
MB-2
MB-1
Site B
I.L.W. TRENCHES (NOT IN USE)
CLINCH RIVER
WO-4
WO-3
WHITE OAK DAM
▲ SAMPLING STATION
----- APPROXIMATE BOUNDARY OF ORNL COMPLEX
1000
0
1000
2000
FEET

BUDGET

It is extremely difficult to define what information is available or being retrieved regarding water quality and sediment parameters on the ORNL compound. We are therefore presenting two budgets. The first includes only manpower, analytical and equipment and supplies necessary for the biological monitoring. The second includes both the biological and the sediment and water quality sampling costs. If data become available from the efforts of the Operations and Health Physics Divisions, the second budget would be reduced appropriately.

Start Date April 1, 1978

FY 1978			FY 1979		
Man-years 2.5	-	130 K	Man-years 2.5	-	135 K
Analytical Soil, Litter, Tissue, etc.	-	74 K	Analytical Soil, Litter, Tissue, etc.	-	74 K
Equipment and Supplies	-	6 K	Equipment and Supplies	-	6 K
TOTAL		210 K	TOTAL		210 K

Budget 1 = 420 K

Sediment and Water Quality Analysis for Adjoining Stations - 350 K

FY 1978	FY 1979
210 K	210 K
175 K	175 K
385 K	385 K

Budget 2 = 770 K

ORNL/TM-7509/V2

Contract No. W-7405-eng-26

TECHNICAL BACKGROUND INFORMATION FOR THE ORNL ENVIRONMENTAL AND SAFETY REPORT

Volume 2

A Description of the Aquatic Ecology of White Oak Creek Watershed and the Clinch River below Melton Hill Dam

J. M. Loar
J. A. Solomon
G. F. Cada

ENVIRONMENTAL SCIENCES DIVISION
Publication No. 1852

Date Published: October 1981

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74. Kenneth E. Yates, Licensing Coordinator, Clinch River Breeder Reactor Project, P.O. Box U, Oak Ridge, TN 37830
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APPENDIX 6

MINUTES OF MEETING TO DETERMINE MERCURY CONCENTRATION IN AREA STREAMS
(MEMORANDUM FROM D. L. MASON TO DISTRIBUTION, DATED MAY 4, 1982)
(Marginal Comments-W. Van Winkle)

HSEA82A-0504-148

UNION CARBIDE

NUCLEAR DIVISION

INTERNAL CORRESPONDENCE

May 4, 1982

J. G. Dorsey, 9995, MS 2
V. W. Lowe, 9723-11A
M. Mitchell, 1551, MS 127, ORGDP
H. H. Stoner, 9766, MS 7
W. Van Winkle, Jr., 1505, ORGDP
C. Weber, 9723-11A

Minutes of Meeting to Determine Mercury Concentrations In Area Streams

The following group of people met May 3, 1982 to discuss execution of an ? experiment to determine mercury concentrations in streams emanating from the Y-12 Plant: Paula Pritz, Julie Dorsey, Hank Stoner, Ron McElhaney, Richard Counts, Victor Lowe, Sandra Schlotzhaver, Jack McLendon, Charles Weber, Jim Underwood and Merwyn Sanders of Y-12; Webb Van Winkle, Jerry Elwood, Steve Hildebrand and Jim Loar of ORNL; and Mike Mitchell of ORGDP.

We want this experiment to determine, in order of priority
1) the concentration, at one instant in time, of mercury in fish, other biota and sediment of the East Fork of Poplar Creek (EFPC).
2) whether mercury continues to be released from the Y-12 Plant.
3) the concentration of mercury in the fish, other biota and sediment of Bear Creek.
4) the concentration of PCB in the fish in EFPC and Bear Creek.

consider New Hope Pond part of

? We acknowledged two constraints. First, the work needs to be complete by May 21. Second, where possible sampling locations should duplicate previous experiments, particularly the most recent plant sampling by an ORNL employee.

The responsibilities were defined as below:
- Van Winkle et al, will design the experiment, collect samples and write the report.
- Lowe will participate in the experiment design, provide statistical analysis, and determine the measurement precision and accuracy.
- Weber will determine the consistency of the analytical results with previous experiments
- Dorsey will provide analytical support.
- Stoner will provide overall program coordination.

During the meeting it was agreed that

- the analysis will be for total mercury;
- there is not time, nor does there appear to be a real need, for intra-laboratory comparisons;
- samples taken from EFPC and Bear Creek will be analyzed by Y-12 personnel;
- ? we will not be able to determine how much of the mercury originated in the Y-12 Plant.

Van Winkle presented an experimental design. It was accepted with minor modification.

As soon as possible fish samples will be collected in Poplar Creek for Mike Mitchell. He asked that these samples be analyzed at ORGDP.

DLMason

D. L. Mason, 9723-14, MS 1

DLM:pc

cc: J. C. White
File - DLM - NoRC

APPENDIX 7

MERCURY CONTAMINATION IN NEW HOPE POND, EAST FORK POPLAR CREEK, AND BEAR CREEK

(Briefing for Y-12 Plant Management, June 2, 1982, W. Van Winkle)

MERCURY CONTAMINATION
IN NEW HOPE POND, EAST FORK POPLAR CREEK, AND BEAR CREEK

BRIEFING FOR Y-12 PLANT MANAGEMENT

JUNE 2, 1982

W. VAN WINKLE
ENVIRONMENTAL SCIENCES DIVISION
OAK RIDGE NATIONAL LABORATORY

OBJECTIVES (IN ORDER OF PRIORITY)

- DETERMINE HG CONCENTRATION IN FISH, OTHER BIOTA, AND SEDIMENTS IN EAST FORK POPLAR CREEK (EFPC)

- DETERMINE WHETHER HG CONTINUES TO BE RELEASED FROM Y-12

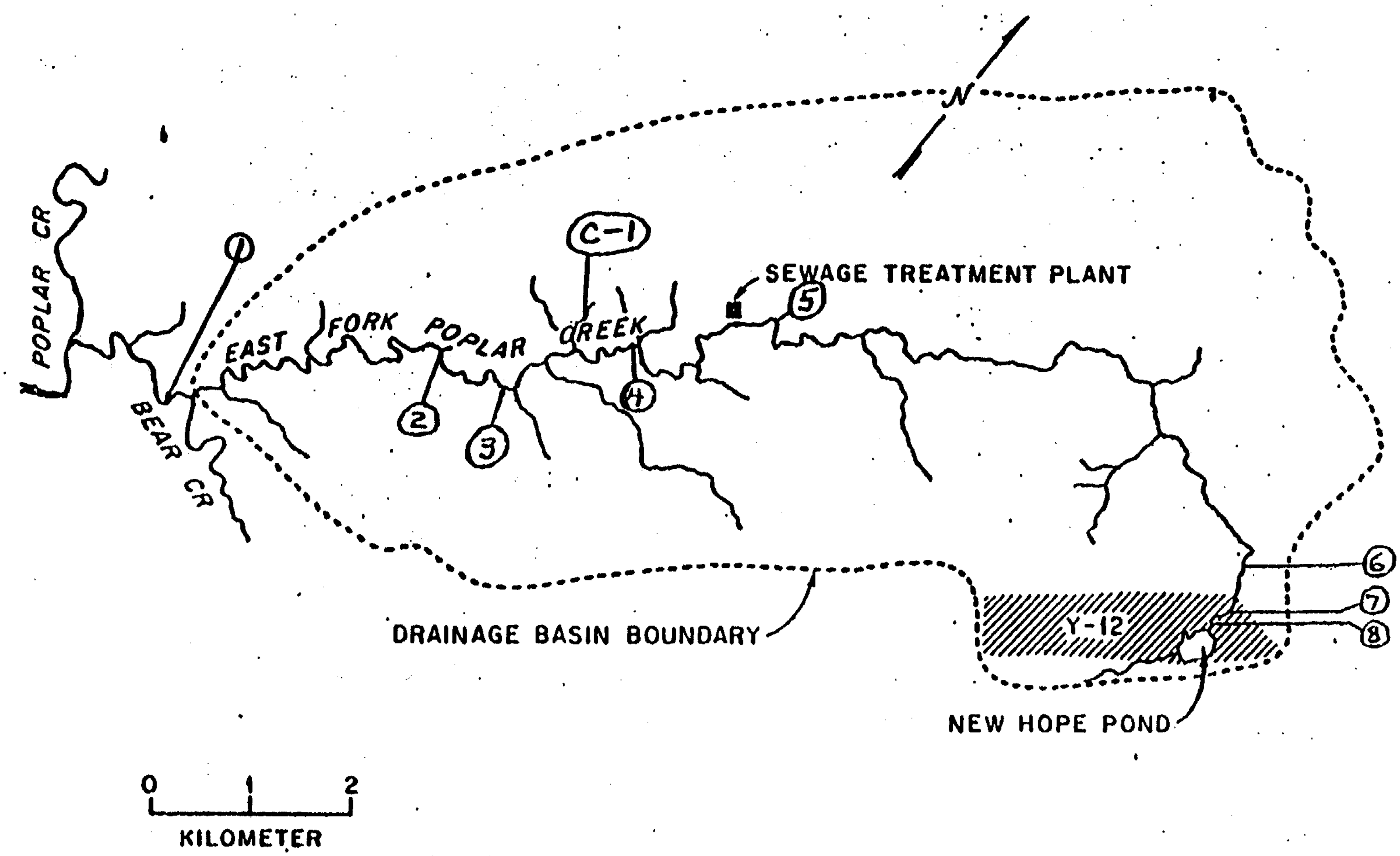
- DETERMINE HG CONCENTRATION IN FISH, OTHER BIOTA, AND SEDIMENT IN BEAR CREEK (BC)

Table 1. Station number, river mile, and type of sample collected at each site on East Fork Poplar Creek and Bear Creek

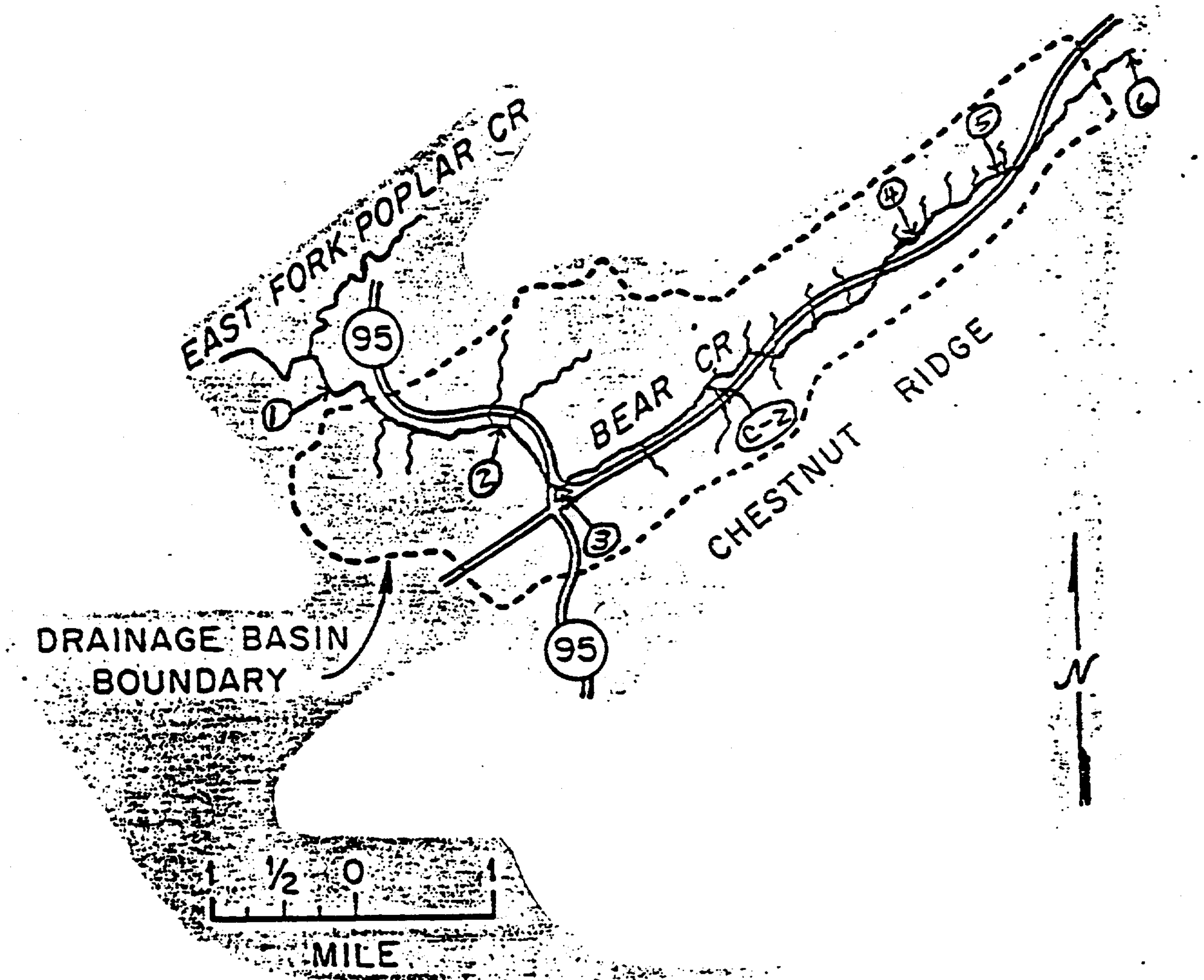
Station Number	Station RM[a]	Sediment	Fish	Liverwort and moss	Pasture grass
		East Fork Poplar Creek			
1	1.3	X	X	X	
2	4.8	X		X	
3	5.5				X
4	6.8	X			
5	8.3	X	X		X
6	13.8	X		X	
7	14.1	X	X		
8	14.2	X	X		
		Bear Creek			
1	0.4	X	X		
2	2.0			X	
3	2.8	X			
4	6.0	X			
5	7.1	X			
6	7.6	X			

[a]River mile relative to confluence with Poplar Creek for East Fork Poplar Creek and with East Fork Poplar Creek for Bear Creek.

ORNL-DWG 76-6681



East Fork Poplar Creek drainage.



Bear Creek drainage.

PRECISION AND ACCURACY

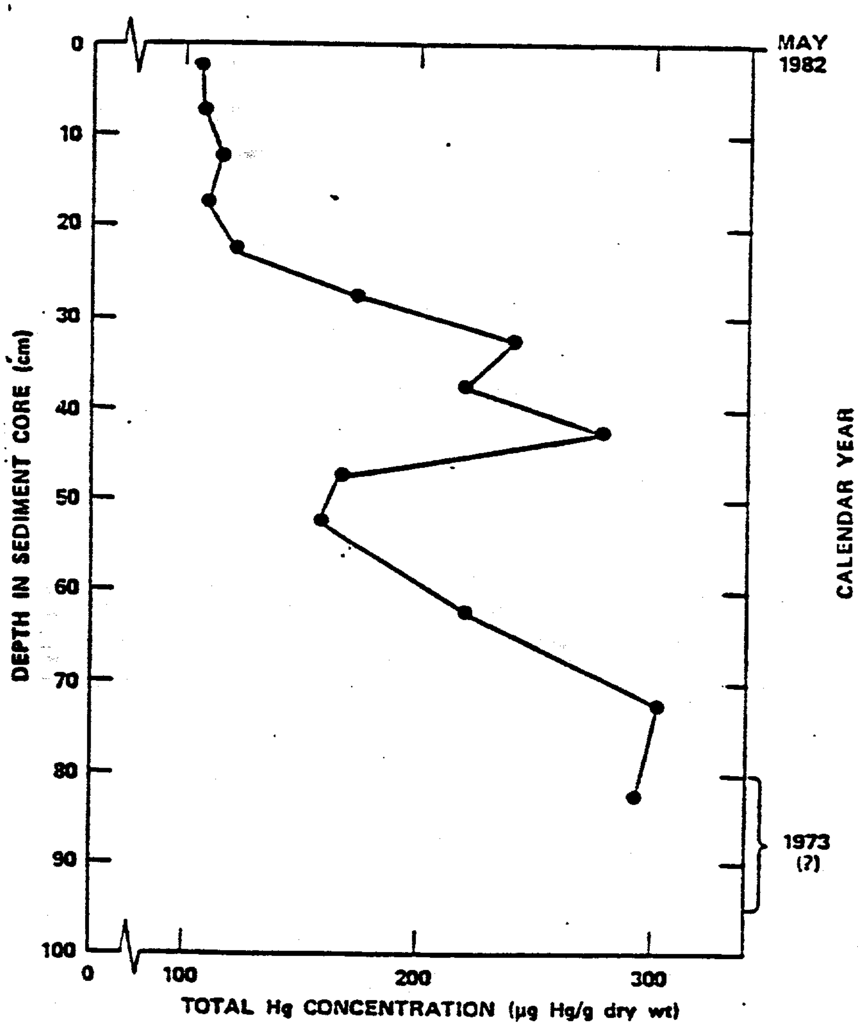
- AVERAGE COEFFICIENTS OF VARIATION (A MEASURE OF PRECISION) ARE APPROXIMATELY 10% OR LESS FOR EACH OF THE FOUR SAMPLE TYPES

- ACCURACY

  - WITHIN 0.1 PPM AT HG CONCENTRATIONS $\leq$1.1 PPM
  - NEEDS FURTHER EVALUATION AT HIGHER CONCENTRATIONS

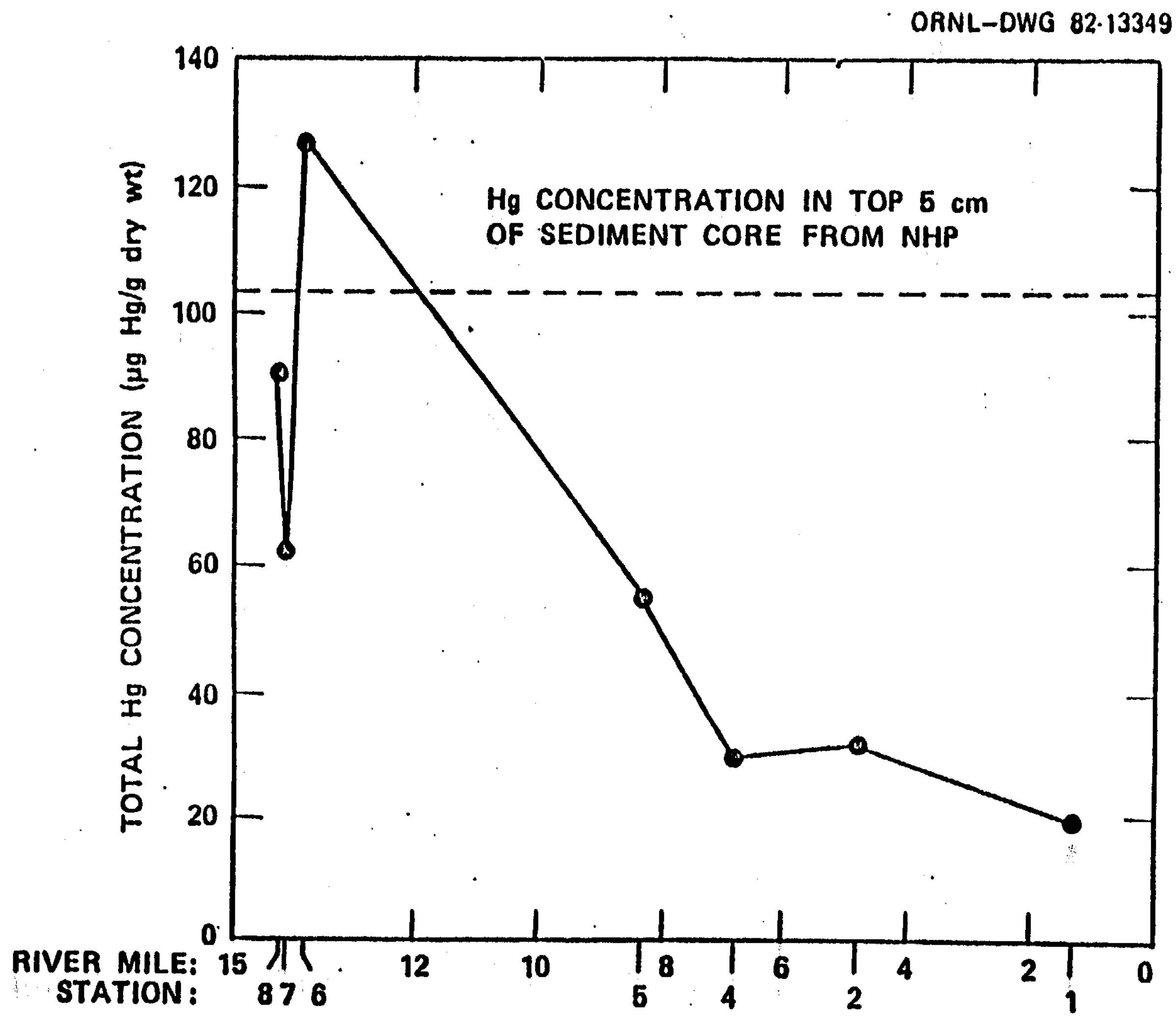
RESULTS FOR SEDIMENTS IN NHP

- 100 PPM AT SURFACE VS < 1 PPM BACKGROUND
- UP TO 300 PPM IN SUBSURFACE SEDIMENTS
- APPARENT DECREASE SINCE 1973. MAY BE DUE TO ABSENCE OF HIGH RUNOFF-PRODUCING STORMS SINCE 1977
- NEED 1 OR MORE TAGS TO DATE LAYERS



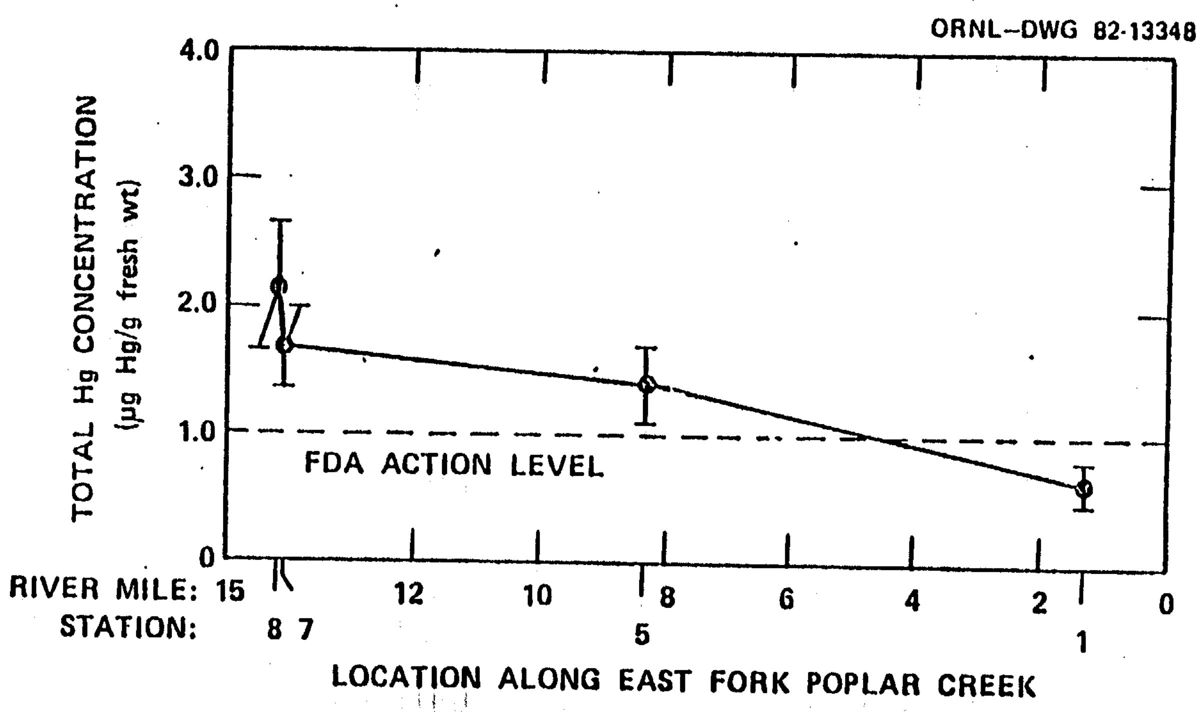
RESULTS FOR SEDIMENTS IN EFPC

- [HG] AT STATIONS 6, 7 & 8 $\simeq$ [HG] IN SURFACE SEDIMENTS OF NHP $\Rightarrow$ COMMON SOURCE
- [HG] DECREASES WITH DISTANCE DOWNSTREAM $\Rightarrow$ DILUTION WITH UNCONTAMINATED SEDIMENT
- [HG] AT ALL STATIONS EXCEED BACKGROUND BY A FACTOR OF 60 OR MORE.



RESULTS FOR BLUEGILL IN EFPC

- POSITIVE CORRELATION BETWEEN [HG] AND WEIGHT OF BLUEGILL
- [HG] DECREASES WITH DISTANCE DOWNSTREAM
- [HG] IN 87% OF BLUEGILL FROM STATIONS 5, 7 & 8 EXCEED FDA ACTION LEVEL



RESULTS - MOSSES AND LIVERWORTS

- HG CONCENTRATION IN MOSS DECREASES WITH DISTANCE DOWNSTREAM IN EFPC

- MOSSES AND LIVERWORTS ARE NOT PART OF ANY FOODCHAIN LEADING TO MAN. THEREFORE, THE ELEVATED HG CONCENTRATION FOUND IN THESE PLANTS IS NOT A DIRECT HEALTH CONCERN.

RESULTS - PASTURE GRASSES ALONG EFPC

- HG CONCENTRATION AVERAGES 3.5 PPM FOR DEAD FOLIAGE AND 0.2 PPM FOR LIVE FOLIAGE FOR PASTURE GRASS ON THE FLOODPLAIN OF EFPC

- CALCULATIONS INDICATE HG CONCENTRATION IN MILK FROM COWS GRAZING ALONG EFPC PRESENTS NO HEALTH HAZARD

- CALCULATIONS INDICATE HG CONCENTRATION IN BEEF FROM CATTLE GRAZING ALONG EFPC MAY EXCEED 1.0 PPM

RESULTS - BEAR CREEK

- SEDIMENT
  - 13 PPM NEAR SETTLING BASINS (RELATIVE TO 100 PPM FOR EFPC IMMEDIATELY BELOW NHP)
  - HG CONCENTRATION DECREASES WITH DISTANCE DOWNSTREAM TO BACKGROUND LEVELS
  - Y-12 NOT A SIGNIFICANT ACTIVE SOURCE FOR HG

- FISH
  - HG CONCENTRATION, EXCEPT FOR ONE ROCK BASS, DID NOT EXCEED FDA ACTION LEVEL FOR HG IN FISH MUSCLE OF 1.0 PPM

- MOSS
  - HG CONCENTRATION SLIGHTLY ABOVE BACKGROUND, BUT MORE THAN A FACTOR OF 10 LOWER THAN FOR MOSS FROM EFPC

RECOMMENDATIONS - SPECIFIC ACTIONS

- LIMIT LOSS OF HG ASSOCIATED WITH SEDIMENTS FROM Y-12
  - IDENTIFY AND STABILIZE (OR PHYSICALLY ISOLATE) THE AREA YIELDING HG CONTAMINATED SEDIMENTS
  - DESIGN AND IMPLEMENT FUTURE DREDGING PLANS FOR NHP TO MINIMIZE SEDIMENT RESUSPENSION AND LOSS TO EFPC

- CONSIDER THE FOLLOWING ACTIONS IN LIGHT OF HG CONCENTRATIONS FOUND IN FISH IN EFPC
  - NOTIFY TN DEPT PUBLIC HEALTH & SUGGEST POSTING NON-DOE PROPERTY ALONG EFPC WITH APPROPRIATE SIGNS FOR BOAT FISHERMEN AND BANK FISHERMEN
  - POST DOE PROPERTY ALONG EFPC WITH APPROPRIATE SIGNS FOR BANK FISHERMEN

- CONSIDER THE FOLLOWING ACTION IN LIGHT OF HG CONCENTRATIONS CALCULATED FOR BEEF: BUY AND SLAUGHTER AN OLDER COW AND MEASURE THE CONCENTRATION OF MERCURY IN VARIOUS ORGANS AND TISSUES CONSUMED BY HUMANS

RECOMMENDATIONS - FURTHER MONITORING

- EVALUATE FURTHER THE HISTORICAL HG RECORD IN NHP SEDIMENTS BY
  - MEASURING HG CONCENTRATION IN SEDIMENT CURRENTLY ENTERING NHP
  - OBTAINING AND ANALYZING ADDITIONAL CORES
  - ESTABLISHING ABSOLUTE CHRONOLOGY OF HG DEPOSITION IN NHP

- MONITOR HG CONCENTRATION IN SEDIMENTS IN EFPC EVERY TWO YEARS AND IN BEAR CREEK EVERY FIVE YEARS

- FOLLOWING THE START OF OPERATION OF THE NEW WEST END SEWAGE TREATMENT PLANT, MONITOR IN EFPC:
  - HG CONCENTRATION IN FISH
  - ABUNDANCE AND SIZE DISTRIBUTION OF DOMINANT SPORT FISH POPULATIONS
  - SPORT FISHING EFFORT AND CATCH

APPENDIX 8

ABSTRACT, INTRODUCTION, CONCLUSIONS, RECOMMENDATIONS, AND DISTRIBUTION LIST FROM W. VAN WINKLE ET AL., "MERCURY CONTAMINATION IN EAST FORK POPLAR CREEK AND BEAR CREEK," SEPTEMBER 7, 1982

OAK RIDGE NATIONAL LABORATORY
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NUCLEAR DIVISION
POST OFFICE BOX X
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ORNL
CENTRAL FILES NUMBER
ORNL/CF-82/257

DATE: September 7, 1982

SUBJECT: MERCURY CONTAMINATION IN EAST FORK POPLAR CREEK AND BEAR CREEK

TO: DISTRIBUTION

FROM: W. Van Winkle, R. W. Counts, J. G. Dorsey, J. W. Elwood, V. W. Lowe, Jr., R. McElhaney, S. D. Schlotzhauer, F. G. Taylor, Jr., and R. R. Turner

ABSTRACT

A one-month study was performed at the request of Y-12 Plant management to determine the concentration of mercury in sediment, fish, moss, and pasture grass in the East Fork Poplar Creek (EFPC) and Bear Creek drainages and to determine whether mercury is still being released from the Y-12 Plant.

Total mercury concentration in a sediment core from New Hope Pond was 100 μg/g dry wt at the surface and up to 300 μg/g dry wt in subsurface sediments, relative to background concentrations of less than 0.3 μg/g dry wt. There has been an apparent decrease since 1973 in mercury concentration of sediment entering New Hope Pond. The decrease since 1977 may be due to the absence of high runoff-producing storms since 1977, although one or more intermediate layers in the core need to be dated to establish the absolute chronology of mercury deposition in New Hope Pond over the period 1973-1982. Mercury concentration in sediment of EFPC immediately below New Hope Pond is similar to the concentration in the surface sediment of New Hope Pond, thus suggesting a common and currently active source for the mercury in the creek and the pond. Mercury concentration in the sediment decreases with distance downstream, indicating dilution of the contaminated sediment with uncontaminated sediment from tributary drainages entering East Fork Poplar Creek. Mercury concentration at all stations on EFPC exceeded background by a factor of 60 or more.

Total mercury concentration in muscle tissue of bluegill from EFPC was positively correlated with body weight, as expected. Although there was a decrease in concentration with distance downstream, mercury concentration in 87% of the bluegill collected at the three upstream locations exceeded the Food and Drug Administration (FDA) action level for mercury in the edible portion of fish of 1.0 µg/g fresh wt. Total mercury concentration in moss, as in sediments and bluegill, decreased with distance downstream in EFPC. Total mercury concentration averaged 3.5 and 0.2 µg/g fresh wt for dead and live foliage in pasture grass, respectively, on the flood plain of EFPC. Calculations indicate that mercury concentration in milk from cows grazing along EFPC presents no health hazard, but calculations indicate that mercury concentration in beef may exceed 1.0 µg/g fresh wt.

Results for Bear Creek indicate that this drainage is considerably less contaminated with mercury than East Fork Poplar Creek. The concentration in the sediment was 13 µg/g dry wt near the settling basins at the west end of the Y-12 Plant area, but decreased to background concentrations before the confluence of Bear Creek with EFPC. Total mercury concentration in fish, except for one rock bass, did not exceed the FDA action level. The concentration in moss was slightly above background, but was more than a factor of 10 lower than that for moss from EFPC.

Recommendations are made (1) to limit the quantity of mercury released from the Y-12 Plant area into EFPC, (2) to consider notifying the responsible state agencies and fishermen concerning mercury concentrations found in fish in EFPC, and (3) to measure mercury concentration in hair from cattle grazing on pasture grasses along EFPC. Recommendations concerning further monitoring are also made.

~~ACKNOWLEDGMENTS~~

The authors thank C. F. Baes, S. G. Hildebrand, S. E. Lindberg, J. M. Loar, and J. P. Witherspoon for their critical review of this report. The authors also thank D. K. Cox, L. A. Ferren, S. B. Gough, W. C. Kyker, P. Lowry, and P. D. Parr for their assistance in collecting and processing the samples; and M. L. Mann, R. E. Slagle, H. L. Tucker, R. A. Viator, and L. E. White for their assistance in digesting and analyzing the samples. This study was funded by the Y-12 Environmental Management Department. Publication No. 2051, Environmental Sciences Division, ORNL.

1. INTRODUCTION

In April 1982, the Environmental Sciences Division at Oak Ridge National Laboratory, in collaboration with analytical chemists and statisticians from the Y-12 Plant, was requested to design, execute, and report on a short-term study of mercury contamination in East Fork Poplar Creek (EFPC) and Bear Creek (BC), the two drainages for the Y-12 Plant area. The objectives, in order of priority, were to determine (1) the concentration of mercury in fish, other biota, and sediment of EFPC as of May 1982, (2) whether mercury continues to be released from the Y-12 Plant, and (3) the concentration of mercury in fish, other biota, and sediment of BC (memo from D. L. Mason to J. G. Dorsey et al., dated May 4, 1982). A fourth objective, not covered in this report, was to determine the concentration of PCBs and uranium in fish, other biota, and sediment in East Fork Poplar Creek and Bear Creek.

The study was constrained by the requirement that the work be complete by May 21, except for this report itself. As a result, sample types, number of sampling stations, and number of samples were selected to result in approximately 150 analyses for total mercury.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

4.1.1 Analytical Precision and Accuracy

1. Based on duplicate analyses, average coefficients of variation (a measure of precision) were approximately 10% or less for each of the four sample types.
2. Accuracy at mercury concentrations $\leq$ 1.1 µg/g was within 0.1 µg/g. Accuracy at higher concentrations requires further evaluation.

4.1.2 Sediment

1. Surface sediments in New Hope Pond (NHP) have high mercury concentrations ($\sim$ 100 µg/g dry wt) relative to expected natural background concentrations (< 1 µg/g dry wt).
2. Subsurface sediments in NHP have higher mercury concentrations (up to $\sim$ 300 µg/g dry wt) than surface sediments.
3. Based on the sedimentary record in NHP the mercury concentration in sediment washing into NHP has varied considerably, but appears to have decreased since the last major dredging of the pond. This conclusion is clouded by some uncertainties arising from the absence of any high runoff-producing storms during the past five years and needs further study to verify.
4. Mercury concentrations in fine-grained sediments (< 0.125-mm particle size) in East Fork Poplar Creek (EFPC) immediately below NHP are similar to those in surface sediments in NHP, suggesting an active and common source in the Y-12 Plant area.

5. Mercury concentration decreases in fine-grained sediments in EFPC with increasing distance from NHP, suggesting simple dilution of a point source of mercury located at, or upstream of, NHP.
6. Mercury concentration in all fine-grained EFPC sediments tested, including those collected 23 km (14 miles) downstream of NHP, exceeded natural background concentration by a factor of 60 or more.
7. The Y-12 Plant area does not appear to be a significant active source of mercury for Bear Creek sediments. Although mercury concentration in fine-grained sediment from the headwaters is elevated by a factor of approximately 40 over natural background concentration, downstream sediment contained essentially background concentration of mercury.

4.1.3 Fish

1. Data for bluegill and rock bass support the generalization of a positive correlation between mercury concentration and fish weight.
2. There is a decreasing downstream trend in mercury concentration in bluegill in EFPC that is consistent with the trend observed for sediments and that supports the conclusion of a sustained mercury source in the headwaters of EFPC.
3. Mercury levels in 87% of the bluegill collected in the upper reaches ($\geq$ RK 13) of EFPC exceed the FDA "action level" for mercury in the edible portion of fish of 1.0 μg/g fresh wt.

4. Mercury levels in bluegill and all but one rock bass collected in BC did not exceed the FDA "action level," although all specimens contained mercury concentrations in excess of background concentrations.

5. Contaminated sediments are the probable indirect source of mercury for the fish in EFPC and BC.

6. Based on earlier work, it is reasonable to expect that the majority of mercury in fish in EFPC and BC is in the methylmercury form, which is more chronically toxic to man than other forms of organic and inorganic mercury.

7. Human consumption of fish from EFPC containing more than 1.0 µg/g fresh wt mercury is likely, although the frequency and quantity of consumption are unknown.

4.1.4. Moss and Liverwort

1. There is a decreasing downstream trend in mercury concentration in moss in EFPC.

2. Mercury concentrations in moss from Bear Creek are appreciably lower than those in moss from EFPC.

3. Because moss and liverwort are not part of any food chain leading to man, the elevated mercury concentrations found in these plants are not a direct health concern.

4.1.5. Pasture Grass

1. Mercury concentration averages 3.5 µg/g fresh wt for dead foliage and 0.2 µg/g fresh wt for live foliage for pasture grass in the floodplain of EFPC.

2. Calculations indicate mercury concentration in milk from cows grazing along EFPC presents no health hazard.
3. Calculations indicate mercury concentration in beef from cattle grazing along EFPC may exceed 1.0 μg/g fresh wt.

4.2 RECOMMENDATIONS

4.2.1 Specific Actions

1. Consider the following actions to limit the quantity of mercury lost with sediments from the Y-12 Plant area:
   a. identify, decontaminate, and stabilize (or physically isolate) the area(s) yielding mercury-contaminated sediments to New Hope Pond; and
   b. design and implement future dredging plans for NHP to minimize sediment resuspension and loss to EFPC.
2. Consider the following actions in light of mercury concentrations found in fish in EFPC:
   a. notify the Tennessee Department of Public Health of the mercury contamination of fish in EFPC; and
   b. post DOE property at those locations along EFPC used by bank fishermen and boat fishermen.
3. Consider the following action in light of mercury concentrations calculated for beef from cattle grazing along EFPC: measure the concentration of mercury in hair from cattle or horses grazing along EFPC.

4.2.2 Further Monitoring

1. Evaluate both the analytical and total procedural accuracy of the Y-12 analytical method at mercury concentrations greater than 1.1 µg/g using blind reference standards.
2. Evaluate further the historical mercury record contained in New Hope Pond sediments by
   a. measuring mercury concentrations in sediment as a function of sediment load currently washing into New Hope Pond,
   b. obtaining and analyzing additional sediment cores, and
   c. establishing an absolute chronology of mercury deposition in the pond.
3. Monitor mercury concentration in sediments in EFPC every two years and in Bear Creek every five years.
4. Following the start of operation of the new West End Sewage Treatment Plant, monitor in EFPC
   a. mercury concentration in fish,
   b. abundance and size distribution of the dominant sport fish populations, and
   c. sport fishing effort and catch.

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APPENDIX 9

MEMORANDA RELATING TO THE MAY 1982 SURVEY DONE BY
THE ENVIRONMENTAL SCIENCES DIVISION FOR ORGDP
ON MERCURY LEVELS IN THE FISH IN POPLAR CREEK

From A. C. Stiff to M. Mitchell, dated October 8, 1982
From W. Van Winkle to M. Mitchell, dated October 14, 1982
From W. Van Winkle, Memorandum of Conversation with Mike Mitchell, June 8, 1983

From Mike Mitch.
10/15

NUCLEAR DIVISION

INTERNAL CORRESPONDENCE

October 8, 1982

K/TL/AT-174

X 48221

M. Mitchell, K-1551, MS-127

Poplar Creek Fish Analysis Program for the Determination of Methylmercury, Polychlorinated Biphenyls (PCBs), and Uranium

The results from the fish analysis program are presented in Table 1. The data for PCBs determined as the 1260 Aroclor, indicate very low concentrations are present in almost all samples. Uranium concentrations are also very low. The methylmercury results, expressed as μg/g of Hg in fish, are significant (greater than or equal to 0.5 μg Hg/g fish) in 18% of the samples.

Environmental and Effluent Analysis Procedure EC440[1] was used for PCB determination. Two- to five-gram samples were digested in methanolic potassium hydroxide and extracted with diethyl ether. The ether was taken to dryness under nitrogen and the residue redissolved in hexane. The resulting solution was analyzed by gas chromatography. The chromatograms showed a pattern of peaks most consistent with Aroclor 1260 and were quantitated as such based on a six-peak identification. The U.S. Environmental Protection Agency (EPA) control for PCBs in fish (concentrate No. 1) was used in developing the method and as a control throughout the program. The use of this control demonstrated the method's ability to separate and recover PCBs from fish. Results from 12 replicate analysis of the EPA control are presented in Table 2. Our results for this standard are biased high by approximately 0.5 μg 1260/g fish. This is probably due to the presence of Aroclor 1254 which was not taken into account but has overlapping peaks.[2] The samples taken from Poplar Creek may also contain traces of the 1254 Aroclor. In spite of this high bias, the results are well below the FDA limit of 5 ppm.[3] The detection limit of 0.1 μg/g for PCBs in fish based on a 3 g sample has been set. The precision of the method at the 95% confidence limit is ±0.3 μg PCB per gram of fish, at EPA reference standard levels.

The method for uranium determination in fish was based on tri-n-octylphosphineoxide (TOPO) extraction followed by fluorimetric detection. In order to conserve time and sample preparation on aliquot from the PCB digest was taken for uranium determination. The sample is acidified with nitric acid and extacted with TOPO. An aliquot of the extract is removed for fusion followed by fluorescence detection. This extraction-fluorometric procedure is similar to Environmental Analysis Procedures EC 370 and EC 470 for soils, sediments, and vegetation.[1] Studies performed on spiked fish samples indicated that if the TOPO was allowed to equilibrate for several hours after extraction, recovery of uranium from the digest was essentially 100%. The detection limit is 0.003 μg/g for uranium in fish.

The method for methylmercury determination was based on the work of Oda and Ingle.[4] This procedure involves the selective reduction of inorganic and organic mercury sequentially to mercury vapor in the same sample solution. The mercury vapor is volatilized and determined by cold vapor atomic absorption. Under the experimental conditions, stannous chloride reduces only inorganic mercury to elemental mercury which swept out of the cell and its absorbance measured. Sodium borohydride then reduces the remaining organic mercury in the sample to Hg vapor which is volatilized and determined by Atomic Absorption. It is assumed that all organomercury is present as methylmercury.(5,6) No control samples for methylmercury in fish were available at the time of analysis thus recovery studies were based on spiked samples of fish. All methylmercury concentrations are expressed as micrograms Hg per gram of fish rather than μg methylmercury per gram of fish. The precision of the method based on triplicate analysis of 8 fish samples is ± 0.04 μg Hg/g fish. The detection limit has been set at 0.05 μg Hg per gram of fish for a 0.5 g sample.

The development and routine analysis of these samples were directed by "low level" laboratory of the Environmental, Industrial Hygiene and Radiochemical Analysis section. The analysis for PCBs and uranium was carried out in this section also. The methylmecury analysis was performed in the Spectrochemical Analysis section. Please call me if you have any questions or require further evaluation of the data.

Ann C. Stiff

A. C. Stiff, K-1004-B, MS-446 (6-5769)

ACS:bss

cc: D. W. Frazier, K-1546-F, MS-440
J. G. Million, K-1004-B, MS-449
R. W. Morrow, K-1004-C, MS-440
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Table 1. Results from Fish Analysis Program

Location (Poplar Creek)	Sample Code	Species	Length (cm)	Weight (gram)	Sex	PCBs as 1260 μg/g Fish	Uranium μg/g Fish	CH_3Hg^+ as Hg μg/g Fish
PC-1	1	Yellow Bass	16.8	54.5	F	0.1	0.007	0.25
"	2	" "	17.6	65.5	F	<0.1	0.007	0.20
"	3	" "	17.5	63.1	M	0.2	<0.003	0.18
"	4	" "	17.7	65.4	F	<0.1	<0.003	0.09
"	5	" "	16.5	58.6	M	0.1	0.004	0.18
"	6	" "	17.1	62.4	M	0.2	0.010	0.11
"	7	" "	14.0	32.8	M	<0.1	0.012	0.10
"	8	" "	14.1	32.8	F	<0.1	0.011	0.08
"	9	" "	13.0	28.4	M	0.1	0.010	0.06
"	10	" "	13.5	28.5	M	<0.1	0.018	0.09
"	11	Drum	22.6	132.7	M	<0.1	0.007	0.08
"	12	"	16.0	38.7	M	<0.1	0.015	0.07
"	13	Bluegill	15.7	84.7	F	<0.1	0.009	0.07
"	14	"	13.7	54.3	M	<0.1	0.007	0.15
"	15	"	14.7	72.7	M	<0.1	0.007	0.23
"	16	"	12.2	36.0	M	<0.1	0.004	0.32
"	17	"	11.3	31.6	F	<0.1	0.009	0.24
"	18	Striped Bass	14.1	23.0	?	0.2	0.008	0.08
"	19	" "	24.0	153.9	M	<0.1	<0.003	<0.05
"	20	White Bass	29.3	315.4	M	<0.1	0.004	<0.05
"	21	Hybrid	38.7	817.1	M	<0.1	0.005	0.28
"	22	Spotted Bass	13.7	35.7	F	<0.1	<0.003	0.11
"	23	Channel Catfish	51.6	1255.6	?	0.4	<0.003	0.34
PC-2	24	Crappie	17.7	50.3	?	0.4	0.009	0.48
"	25	"	20.0	70.2	M	0.3	0.005	0.55
"	26	"	21.8	98.1	M	0.1	<0.003	0.39
"	27	"	21.6	93.8	F	0.1	<0.003	0.46
"	28	"	20.3	85.9	F	0.2	0.004	0.31
"	29	"	20.3	84.3	F	0.2	<0.003	0.34
"	30	"	22.3	108.2	F	0.4	0.004	0.46
"	31	"	19.5	66.1	F	0.2	0.005	0.35
"	32	"	20.5	81.1	F	0.2	0.006	0.40
"	33	"	34.2	546.6	F	0.2	<0.003	0.63
"	34	Yellow Bass	17.2	56.6	F	0.1	0.010	0.52
"	35	" "	18.9	65.9	F	0.2	0.007	0.42
"	36	" "	16.1	46.1	M	0.3	0.013	0.50
"	37	" "	14.6	33.7	F	0.1	0.019	0.09
"	38	" "	16.0	59.9	F	0.1	0.011	0.35
"	39	" "	14.5	31.8	M	0.3	0.013	0.12
"	40	" "	13.4	25.2	M	0.2	0.017	0.07
"	41	" "	13.7	27.3	M	<0.1	0.009	0.14
"	42	" "	11.8	17.9	M	<0.1	0.012	0.43

Table 1. Results from Fish Analysis Program (continued)

Location (Poplar Creek)	Sample Code	Species	Length (cm)	Weight (gram)	Sex	PCBs as 1260 μg/g Fish	Uranium μg/g Fish	CH_3Hg^+ as Hg μg/g Fish
PC-2	43	Drum	24.5	165.8	F	<0.1	0.007	0.52
"	44	Sm. Mouth Bass	14.5	29.0	M	<0.1	0.007	0.58
"	45	Lg. Mouth Bass	13.5	25.0	M	<0.1	0.006	0.64
"	46	" " "	22.9	145.8	F	<0.1	<0.003	1.03
"	47	Bluegill	15.4	58.9	M	<0.1	<0.003	0.69
"	48	"	15.6	81.9	F	<0.1	0.004	0.40
"	49	"	14.6	48.9	F	<0.1	0.017	0.50
"	50	"	13.6	39.9	F	<0.1	0.004	0.40
"	51	"	13.1	45.0	M	<0.1	0.006	0.36
"	52	"	12.1	37.8	F	<0.1	<0.003	0.44
"	53	"	12.1	36.8	M	<0.1	0.009	0.42
"	54	"	10.6	19.4	M	<0.1	<0.003	0.45
"	55	"	10.3	18.7	M	0.1	0.009	0.39
"	56	"	9.3	13.2	M	<0.1	INS	0.33
"	91	Blue Catfish	39.6	492.0	F	<0.1	0.008	0.06
"	92	" "	35.4	341.0	M	<0.1	0.009	0.07
"	93	Channel Catfish	44.1	887.0	F	0.5	0.007	1.07
"	94	" "	55.2	225.5	F	0.7	0.004	0.29
"	95	" "	56.1	1750.0	M	0.5	0.005	0.40
"	96	" "	52.7	1539.0	M	0.3	0.008	0.70
PC-3	57	Crappie	21.7	110.5	F	<0.1	<0.003	0.11
"	58	"	23.0	123.1	F	0.2	<0.003	0.48
"	59	"	22.4	104.1	M	<0.1	<0.003	0.17
"	60	"	24.0	138.3	F	<0.1	<0.003	0.37
"	61	"	21.1	93.1	M	<0.1	0.005	0.15
"	62	"	21.8	105.8	M	<0.1	<0.003	0.42
"	63	"	21.6	91.3	M	<0.1	<0.003	0.23
"	64	Bluegill	19.4	158.4	M	<0.1	0.004	0.35
"	65	"	18.5	135.5	M	<0.1	<0.003	0.47
"	66	"	16.7	106.6	M	<0.1	0.004	0.30
"	67	"	18.9	142.3	M	<0.1	0.004	0.52
"	68	"	17.7	110.3	F	<0.1	0.001	0.78
"	69	"	15.8	74.7	F	<0.1	0.004	0.40
"	70	"	14.0	60.5	M	<0.1	0.004	0.28
"	71	"	13.9	54.8	F	<0.1	0.005	0.24
"	72	"	12.2	31.2	F	<0.1	0.015	0.38
"	73	"	11.7	27.8	F	<0.1	0.006	0.21
"	74	Drum	26.2	163.9	M	0.1	<0.003	0.15
"	75	"	21.9	108.6	M	<0.1	<0.003	0.08
"	76	"	20.3	74.2	M	<0.1	0.004	0.30
"	77	Lg. Mouth Bass	25.1	204.8	M	<0.1	0.003	0.43
"	78	" " "	19.0	76.4	M	<0.1	<0.003	0.59
"	79	" " "	14.9	33.2	M	1.0	0.006	0.38

Table 1. Results from Fish Analysis Program (continued)

Location (Poplar Creek)	Sample Code	Species	Length (cm)	Weight (gram)	Sex	PCBs as 1260 μg/g Fish	Uranium μg/g Fish	CH_3Hg^+ as Hg μg/g Fish
PC-3	80	Sauger	37.5	371.1	M	<0.1	0.003	0.26
"	81	"	44.6	734.6	M	0.2	0.004	0.44
"	82	"	46.9	951.6	F	0.1	0.003	0.70
"	83	"	39.1	484.0	M	0.2	0.025	0.63
"	84	"	38.3	524.1	M	0.2	0.009	0.24
"	85	Blue Catfish	52.7	1313.1	M	0.5	0.007	0.18
"	86	Channel Catfish	31.5	238.2	M	0.1	0.005	0.12
"	87	" "	35.0	352.2	M	0.4	0.013	0.11
"	88	Yellow Catfish	34.8	300.5	M	0.3	0.005	0.06
"	89	" "	47.5	1083.0	M	0.4	0.011	0.15
"	90	" "	37.5	435.2	M	<0.1	0.005	0.11

INS = Insufficient sample

Table 2. Comparison of Reference Values and ORGDP Values for PCBs in Fish Concentrate No. 1[A]

	U.S. EPA Reference Value μg/g	ORGDP value μg/g
PCB 1260	0.92 ± 0.36	1.4 ± 0.3*
PCB 1254	3.12 ± 1.32	
PCB 1242	1.12 ± 0.83	

?

Do these differ signif. or not

* Average of 12 determinations
A At 95% confidence limit ?

REFERENCES

1. Environmental and Effluent Analysis Control Manual, Union Carbide Corporation, Nuclear Division.
2. ASTM, Part 31, Methods for Water, D3534-76-T, 1978.
3. Fed. Regis., 44, 38330 (June 29, 1979).
4. Anal. Chem., 1981, 53, 2305.
5. Environmental Research 1971, 4, 1-69
6. Chemical Fallout; M. W. Miller, G. G. Berg, Eds., Charles C. Thomas, Springfield, IL, 1969, p. 75.

NUCLEAR DIVISION

INTERNAL CORRESPONDENCE

October 14, 1982

TO: M. Mitchell (K-25, Bldg. 1551, Ext. 4-8221)

FROM: W. Van Winkle (X-10, Bldg. 1505, Ext. 4-7399)

W. Van Winkle

Attached are descriptions of sampling sites and methods used by us in our work for you during May and June 1982. Also attached are data sheets giving relevant information on the fish collected at each site.

We are interested in seeing the mercury and PCB data once your analyses are completed. If you need further assistance, please contact me.

WVW/ess

Attachments

SAMPLING SITES AND METHODS

The three sampling sites are indicated in the attached figure as PC-1, PC-2, and PC-3. These are the same three sampling sites in Poplar Creek used during the ORGDP survey in 1977-1978 (Loar, 1981). The trotlines used to collect catfish at station PC-2 on June 3, 1982, were actually set several 100 meters downstream from the triangle in the attached figure at the bend in the river but upriver from the Blair Road bridge. With the exception of using trotlines on June 3 to increase the sample size of catfish, fish were collected and processed as described in Loar (1981, pp. 32-33).

Loar, J. M. (ed.) 1981. Ecological studies of the biotic communities in the vicinity of the Oak Ridge Gaseous Diffusion Plant. ORNL/TM-6714.

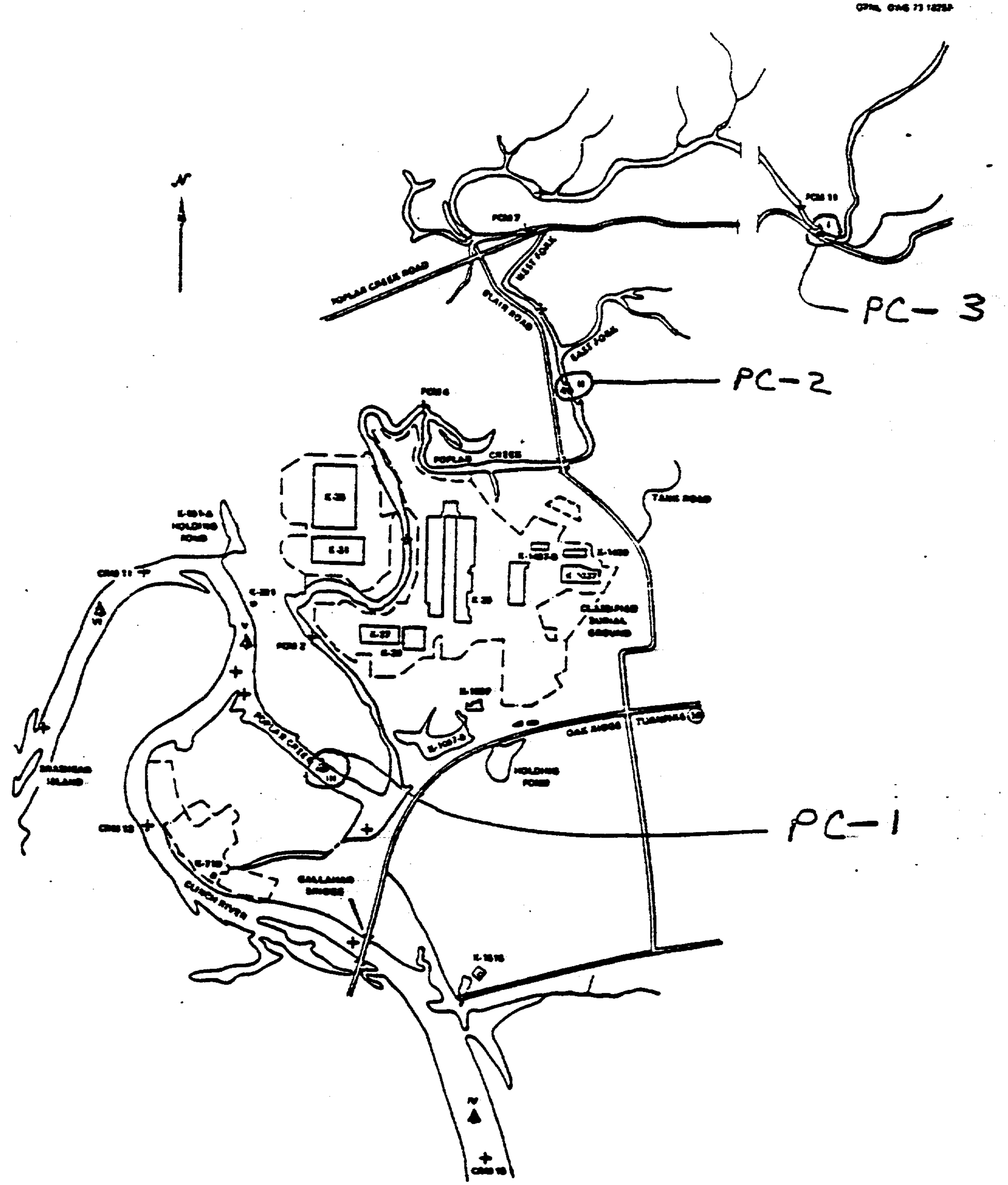


Fig. 1.2-1. Location of the six sites (▲) on Poplar Creek and the Clinch River where biological sampling was conducted during the ORGDP survey, April 1977–September 1978.

FROM: Loar, J. M. (ed.) 1981. Ecological studies of the biotic communities in the vicinity of the Oak Ridge Gaseous Diffusion Plant. ORNL/TM-6714.

Table 1. Fish collected by electrofishing at three locations in Poplar Creek on May 18-19, 1982.

Location	Species	Total length (cm)	Weight (gm)	Sex	Sample code
PC-1	Yellow bass	16.8	54.5	F	1
		17.6	65.5	F	2
		17.5	63.1	M	3
		17.7	65.4	F	4
		16.5	58.6	M	5
		17.1	62.4	M	6
		14.0	32.8	M	7
		14.1	32.8	F	8
		13.0	28.4	M	9
		13.5	28.5	M	10
	Drum	22.6	132.7	M	11
		16.0	38.7	M	12
	Bluegill	15.7	84.7	F	13
		13.7	54.3	M	14
		14.7	72.7	M	15
		12.2	36.0	M	16
		11.3	31.6	F	17
	Striped bass	14.1	23.0	?	18
		24.0	153.9	M	19
	White bass	29.3	315.4	M	20
	Hybrid	38.7	817.1	M	21
	Spotted bass	13.7	35.7	F	22
	Channel catfish	51.6	1255.6	?	23
PC-2	Crappie	17.7	50.3	?	24
		20.0	70.2	M	25
		21.8	98.1	M	26
		21.6	93.8	F	27
		20.3	85.9	F	28
		20.3	84.3	F	29
		22.3	108.2	F	30
		19.5	66.1	F	31
		20.5	81.1	F	32
		34.2	546.6	F	33
	Yellow bass	17.2	56.6	F	34
		18.9	65.9	F	35
		16.1	46.1	M	36
		14.6	33.7	F	37
		16.0	59.9	F	38
		14.5	31.8	M	39
		13.4	25.2	M	40
		13.7	27.3	M	41
		11.8	17.9	M	42
	Drum	24.5	165.8	F	43
	Smallmouth bass	14.5	29.0	M	44

Table 1. (Continued)

Location	Species	Total length (cm)	Weight (gm)	Sex	Sample code
	Largemouth bass	13.5	25.0	M	45
		22.9	145.8	F	46
	Bluegill	15.4	58.9	M	47
		15.6	81.9	F	48
		14.6	48.9	F	49
		13.6	39.9	F	50
		13.1	45.0	M	51
		12.1	37.8	F	52
		12.1	36.8	M	53
		10.6	19.4	M	54
		10.3	18.7	M	55
		9.3	13.2	M	56
PC-3	Crappie	21.7	110.5	F	57
		23.0	123.1	F	58
		22.4	104.1	M	59
		24.0	138.3	F	60
		21.1	93.1	M	61
		21.8	105.8	M	62
		21.6	91.3	M	63
	Bluegill	19.4	158.4	M	64
		18.5	135.5	M	65
		16.7	106.6	M	66
		18.9	142.3	M	67
		17.7	110.3	F	68
		15.8	74.7	F	69
		14.0	60.5	M	70
		13.9	54.8	F	71
		12.2	31.2	F	72
		11.7	27.8	F	73
	Drum	26.2	163.9	M	74
		21.9	108.6	M	75
		20.3	74.2	M	76
	Largemouth bass	25.1	204.8	M	77
		19.0	76.4	M	78
		14.9	33.2	M	79
	Sauger	37.5	371.1	M	80
		44.6	734.6	M	81
		46.9	951.6	F	82
		39.1	484.0	M	83
		38.3	524.1	M	84
	Blue catfish	52.7	1313.1	M	85
	Channel catfish	31.5	238.2	M	86
		35.0	352.2	M	87
	Yellow catfish	34.8	300.5	M	88
		47.5	1083.0	M	89
		37.5	435.2	M	90

Table 2. Information on catfish collected using trot-lines at station PC-2 in Poplar Creek on June 3, 1982.*

Species	Total length (cm)	Weight (gm)	Sex	Sample code
Blue catfish	39.6	492	F	91
Blue catfish	35.4	341	M	92
Channel catfish	44.1	887	F	93
Channel catfish	55.2	2255	F	94
Channel catfish	56.1	1750	M	95
Channel catfish	52.4	1539	M	96

*Water quality parameters at the surface and just above the bottom at 4 meters depth were:

	Surface	Bottom
Temp. (°C)	21.6	21.2
pH	7.1	7.0
Dissolved oxygen (ppm)	5.3	5.0
Conductivity (μmhos/cm)	457.0	462.0

MEMORANDUM OF CONFERENCE OR CONVERSATION

DATE	TIME	
Wednesday, June 8, 1983	11:30 a.m.	[X] TELEPHONE [ ] PERSONAL

ORIGINATING PARTY	OTHER PARTIES
W. Van Winkle	Mike Mitchell (4-8221)
	Environmental Management Department
	Health, Safety, and Environmental Affairs Division, K-25

SUBJECT: Results/reports from the May 1982 survey ESD did with Mitchell's group at K-25

DISCUSSION:

1. The objective of the survey was to provide K-25 with an update on mercury levels in fish muscle to be compared with those obtained by Elwood (1977) and Loar et al. (1981) (sampling done in 1976 and 1977).

2. The data from this survey were not in the recently published Annual Environmental Monitoring Report for the DOE Reservation in 1982. At this point Mike says that no report is planned that would include these data.

3. A copy of my October 14, 1982, memo to Mitchell transmitting the relevant information on each fish collected at each site is attached. Also attached is a copy of an October 8, 1982, memo from the analytical chemist at K-25 (Ann Stiff) to Mitchell on the Poplar Creek Fish Analysis Program for the Determination of Methylmercury, Polychlorinated Biphenyls (PCBs), and Uranium. The concentration of methylmercury exceeded 1.0 ppm in three (3) of ninety (90) fish (two channel catfish and one largemouth bass).

CONCLUSION OR AGREEMENTS

DISTRIBUTION: S. I. Auerbach (w/attachments)
C. W. Gehrs (w/o attachments)

SIGNED W. Van Winkle

UCN-693
(1235 6-68)

APPENDIX 10

DETAILED TASK PLAN FOR FURTHER MERCURY INVESTIGATIONS AT Y-12
(From R. R. Turner to H. H. Stoner, dated September 20, 1982)

UNION CARBIDE

NUCLEAR DIVISION

INTERNAL CORRESPONDENCE

September 20, 1982

To: H. H. Stoner, 9106, MS-5

From: R. R. Turner (4-7856) RRT

Subject: Detailed Task Plan for Further Mercury Investigations at Y-12

Attached is a draft task plan for the subject project developed by myself with considerable input from Vic Lowe, John Napier, and George Kamp. There may still be some rough edges but I believe this draft reflects the consensus of myself and this group.

If you have questions or revisions please do not hesitate to call me.

RRT/chf

Attachment

cc: G. E. Kamp, 9106, MS-5 (6-5971)
V. M. Lowe, 9723-11A, MS-1 (4-2568)
J. M. Napier, 9202, MS-1 (4-1884)
T. Tamura, 1505, Rm. 106 (4-7299)
W. Van Winkle, 1505, Rm. A-246 (4-7399)

PROPOSED FURTHER INVESTIGATIONS OF MERCURY CONTAMINATION IN EAST FORK POPLAR CREEK

Prepared by September 19

R. R. Turner, V. W. Lowe, J. M. Napier, and G. E. Kamp

Introduction

The tasks described in the following sections are directed at (1) identifying chronic and episodic sources of mercury that are contaminating drainage waters from the Y-12 Plant and (2) determining whether New Hope Pond (NHP) is acting as a net source or net sink for mercury emanating from the Y-12 Plant. The initial tasks are described in some detailed whereas subsequent tasks are only outlined generally. The investigative strategy will be to develop more detailed plans for the later tasks based on initial and interim findings.

The tasks will be carried out over a 9-month period beginning in October 1982 and will involve staff from several divisions at Y-12 (Quality, Product Certification, Technical Services) and ORNL (Environmental Sciences, Analytical Chemistry). The project is estimated to require about 1 man-year (~ $100K) divided among several divisions.

Task I - Survey of Mercury in Y-12 Plant Drainage Waters

Beginning in autumn 1982 concentrations of mercury, chloride ion and free chlorine in water flowing into the influent ditch of New Hope Pond (NHP) will be determined on an approximate quarterly frequency. The initial samples (October-November) will be taken during baseflow (dry weather flow), with subsequent samples to include runoff from a storm event (November-December) and runoff following use of deicing salt (January-February). Baseflow will be resampled in late spring (May 1983). In addition, based on the results of the initial baseflow survey, additional samples will be collected at selected upstream drainage confluences to further localize sources of mercury. As areas or pipes yielding significant quantities of mercury become better localized, the form of mercury in water emanating from these areas will be determined to assist in determining appropriate remedial action.

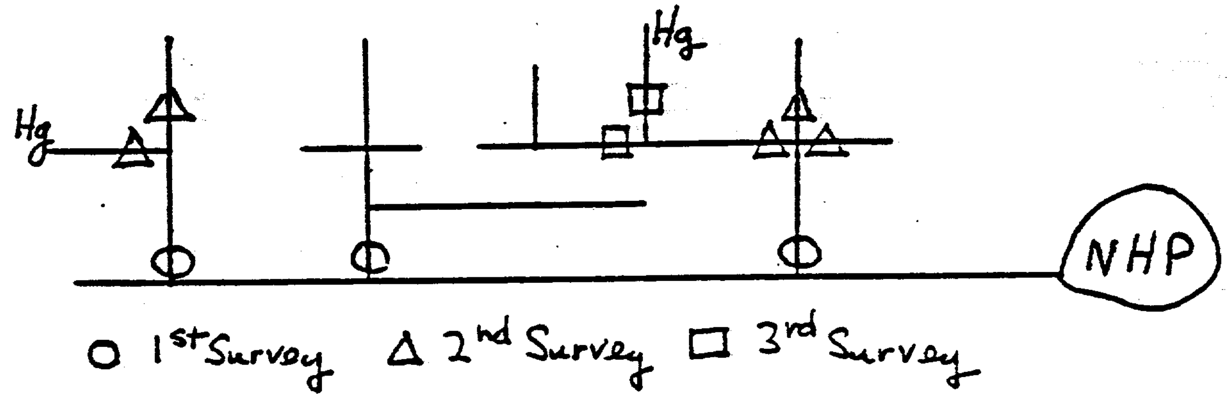
Task I is divided into four subtasks entitled:

(a) initial Baseflow Survey and Source Tracing
(b) Storm Event Survey
(c) Deicing Event Survey
(d) Final Baseflow Survey

Subtask Ia: Initial Baseflow Survey and Source Tracing

Initially (October 1982) water samples will be collected from about 10 of the approximately 70 pipes which are tributary to the influent ditch of NHP. Grab samples for total mercury and chloride ion will be collected from each pipe at 2- to 4-hour intervals of a 24-hour period. Water flow rate in each pipe at the time of sampling will be measured or estimated so that mercury fluxes can be calculated. Specific conductance, pH and free chlorine will be measured in situ to provide correlative data. This initial partial drain survey will be coordinated with the first baseflow mass balance measurements on NHP to maximize the usefulness of the data.

Results of the initial partial drain survey will reveal the approximate magnitude of daily fluctuations in water flow and constituent concentrations. Armed with this information we will design a water sampling strategy to accurately assess mercury fluxes from all pipes that discharge into the NHP influent ditch. The objective will be to identify all pipes that are contributing significant mercury to the NHP influent ditch and to rank the pipes according to their fractional contribution. Pipes which are found to yield significant mercury fluxes will be traced upstream on a follow-up survey and sampled at major confluences to further localize the mercury source. A 'reverse cascade' sampling pattern using grab samples will be used. A hypothetical pattern of this type is illustrated below:



Progressive upstream movement of sampling is delayed until previous results are available and is expected to be increasingly limited by the accessibility of drains. Nonetheless, this approach should focus attention on the approximate locality of each mercury source. For areas or pipes yielding significant quantities of mercury without any identifiable source (e.g., sump, leaky drum), the form (dissolved or particulate) of mercury in water will be determined by filtering through 0.2 μm pore size filters. Information on the form of mercury can be used to determine appropriate remedial action for these sources, such as water diversion or installation of a catch basin.

The total number of samples for mercury analysis for this task cannot be accurately predicted but will likely be less than 300. The actual number will depend on the number of actual mercury sources and their locations relative to the ~70 pipes discharging water to the influent ditch to NHP.

Subtask Ib: Storm Event Survey

All 70 pipes discharging into the influent ditch to NHP will be sampled in November or December 1982 during stormwater runoff. The major objective of the stormwater sampling will be to identify drains which only contribute mercury under stormflow conditions, or which show much higher mercury fluxes during stormflow compared with baseflow.

Stormflow will be somewhat more difficult to sample representatively than baseflow. Our plan is to choose (based on weather forecasts) a storm event for sampling that is likely to yield sustained flows in the 70 pipes for at least 8 hours. Such a condition should arise with rainfall associated with a stalled, or slow moving, regional front rather than from localized thunderstorms or showers. At least one grab sample from each of the drains entering the influent ditch to NHP will be collected for total mercury and chloride ion analyses. Time and continuing stormwater runoff permitting, additional grab samples or composites will be collected. Water flow rates will be measured or estimated insofar as possible to enable flux calculations. The storm event drain survey will be coordinated with mass balance measurements on NHP (see Task II) so that data on the total flux of Hg into NHP under stormflow conditions can be used for both Subtask Ib and Subtask IIb.

Subtask Ic: Deicing Event Survey

The influent to NHP and selected (suggested by previous work) upstream drains will be sampled for total mercury and chloride ion analyses during runoff (from snowmelt or rainfall) following a period (e.g., January or February 1983) of heavy use of deicing salts. Selected samples will also be filtered (0.2 μm pore size) and the filtrate analyzed for total (soluble) mercury and chloride. These resulting mercury and chloride data will be compared with earlier baseflow and stormflow data to ascertain whether higher chloride values associated with snowmelt are correlated with higher mercury concentrations and fluxes.

Subtask Id: Final Baseflow Survey

The final baseflow survey will essentially duplicate the initial baseflow survey and will be conducted in the spring (e.g., May) of 1983. The survey will serve two purposes: (1) it will provide further assurance that all significant mercury sources (chronic) are identified and (2) it will provide information that any remedial actions, taken since the first survey, have been effective. Any pipes found in this survey yielding significant mercury fluxes, which were not previously identified and traced, will be traced upstream using the sampling pattern described in Subtask Ia.

Task II - Mass Balance of Mercury in New Hope Pond

Fluxes of total mercury into and out of New Hope Pond (NHP) will be determined under both baseflow (Subtask IIa) and stormflow (Subtask IIb) conditions to ascertain whether NHP acts as either a net source or net sink of mercury under these contrasting hydrologic conditions. Water samples for total mercury analysis will be collected over at least one hydraulic residence time under each flow regime.

Subtask IIa: Baseflow Mass Balance

Inflow and outflow water samples at NHP will be collected during dry weather (fall 1982 and late spring 1983) over a period sufficiently long to allow at least one exchange of the water volume in the pond (i.e., one hydraulic residence time). The duration of each sampling period will be determined by the inflow rate of water to NHP. Based on the reported average daily inflow of 23,000 cubic meters (Sanders, Y/DD-242, 1979) and an estimated pond volume of 25,000 cubic meters (5 acres by 4 feet deep) the hydraulic residence time should be slightly longer than 24 hours. Thus each sampling period will be at least 24 hours in duration.

Inflow and outflow grab samples will be collected at 2-h intervals, with samples at 6-h intervals being taken in triplicate. This scheme will yield about 50 samples for total mercury analysis. Water samples will be collected directly in specially prepared glass volumetric flasks.

Hydrologic stage height (pond level) is recorded continuously at the NHP outflow structure and flow rates calculated directly from these records.

Stage height records are not available for the inflow to NHP but the influent ditch at the western end of the pond is the only inflow during dry weather. Thus inflow rates should be equivalent to the gauged outflow rates if deep seepage and evaporation are negligible.

Subtask IIb: Stormflow Mass Balance

Inflow and outflow water samples at NHP will be collected during two stormwater runoff events from the Y-12 plant area. Weather forecasts will be used to select storms that will yield moderate runoff over several hours (same criterion as in Task Ib), but which will not likely result in the flow gauging capacity of the pond outflow being exceeded. Grab samples of both inflow and outflow will be collected on a similar schedule to the baseflow schedule (including replicate but may be collected more frequently during peak flow if conditions so justify. The duration of each sampling period will be determined by the nature of the storm hydrograph but will not be shorter than the hydraulic residence time of the pond under the imposed hydrologic conditions. Approximately 50 samples will be collected during each storm for total mercury analysis. To minimize analytical costs some samples may be composited proportional to water flow rate.

Sample Handling and Preparation

Mercury - Samples for total mercury analysis will be collected directly in glass volumetric flasks which have been specially cleaned and prepared for mercury work. The flasks are baked in a large muffle furnace to volatilize any residual mercury and then pre-spiked with dichromate and nitric acid to immobilize and preserve mercury in the aqueous phase. Initially the ORNL Analytical Chemistry Division will prepare the flasks and conduct the analyses. Subsequently, the Y-12 Product Certification Division will assume these operations.

Chloride ion - Samples for chloride ion analysis will be collected in polyethylene bottles at the same time samples for mercury analysis are collected The Y-12 Product Certification Division will conduct the chloride analysis.

Chlorine (free) - Samples for free chlorine analysis will be analyzed immediately in the field using appropriate portable apparatus.

pH and Specific conductance - pH and specific conductance can be measured directly in the field or in subsamples from the chloride samples. In either case measurements will be completed as soon after collection as possible.

Quality Assurance

A program of rigorous sampling and analytical quality control will be followed throughout this project. The QA program will consist of four elements as follows:

(1) Analysis of reference materials - NBS and EPA quality control samples for mercury in water will be submitted periodically in a disguised form to the analytical group to assess accuracy.

(2) Analysis of replicate samples - Within each group of samples submitted for analysis, at least 10% will be replicates (i.e., $N \geq 3$), consisting of either sample splits or multiple samples collected simultaneously from the same location.

(3) Analysis of laboratory drinking water - As part of the initial sample collections, drinking water will also be collected and analyzed for total mercury for comparison with Y-12 drainage waters and to establish analytical credibility.

(4) Interlaboratory analysis - Selected mercury samples will be analyzed by both the Y-12 Product Certification Division and the ORNL Analytical Chemistry Division to assure comparability of results and to better define analytical accuracy.

TASK SCHEDULE AND ANALYTICAL WORK LOAD

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Task I						Draft Interim Report				Draft Final Report		
Initial Baseflow Survey	(300)[a]											
Storm Event Survey			(100)									
Deicing Event Survey				(100)								
Final Baseflow Survey								(100)				
Task II												
Baseflow Mass Balance	(50)						(50)					
Stormflow Mass Balance		(50)										

[a]Approximate number of samples for mercury analysis.

APPENDIX 11

COMMENTS ON DRAFT REPORT ON MERCURY CONTAMINATION IN EAST FORK POPLAR CREEK AND BEAR CREEK

(From C. R. Richmond to W. Van Winkle, dated 10 August 1982)

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

10 August 1982

TO: W. Van Winkle

FROM: C. R. Richmond (4-4333)

SUBJECT: Draft Report on Mercury Contamination in East Fork Poplar Creek and Bear Creek

I have had the subject draft report reviewed by several individuals, and the following comments arise from their perusal of the document.

- The amount of cattle grazed along East Fork Poplar Creek (EFPC) would seem to be rather minimal when considered within the overall population dietary intake. Therefore, the recommendation for further evaluation as a potential public health problem may not be justified. Also, a more detailed analysis of existing data and assumptions used in the calculations might be useful prior to taking this step.

- Identifying and stabilizing any area (if such an area can be found) yielding mercury-contaminated sediments to New Hope Pond would be a very expensive task, considering the past history with attempts to contain mercury spills. Y-12 management will have to consider this point in terms of cost effectiveness.

- Posting of EFPC may be appropriate, depending upon the outcome of any discussions with the Tennessee Department of Public Health. However, any such discussions should be arranged by the appropriate UCC-ND personnel and handled through the Department of Energy's Environmental Protection Branch. Prior to that step, it would also be useful for TVA and DOE to hold discussions on this subject.

- An evaluation of the Y-12 analytical procedure was done during the last mercury study (1975-1977). Perhaps this should be done again.

- The extent of the problem may not justify the cost of the monitoring effort recommended.

CRR:sh

cc: R. G. Jordan

11 August 1982

R. G. Jordan
J. C. White
W. Van Winkle

F.Y.I. Please note this is a "fence post" type calculation. There are still a lot of unanswered questions, e.g., how many cows graze, how many enter the food chain, what fraction of the dietary milk/beef comes from these cows, how many people might eat food from these cows, etc.

Enclosure

CHESTER R. RICHMOND
ASSOCIATE LABORATORY DIRECTOR FOR BIOMEDICAL AND ENVIRONMENTAL SCIEN
BUILDING 4500N, ROOM I-206

Comments on W. Van Winkle, et al., July '82 Draft of ORNL/CF-82
(Prepared by S. R. Bernard, K. F. Eckerman, and S. V. Kaye, 8/6/82)

In this review, mercury levels in humans are estimated from the projected dietary levels using current metabolic models for methyl mercury. Such an exercise has been, in principle, carried out by FDA in their establishment of the necessary standard.

MERCURY METABOLISM

ICRP 30 In Publication 30 of the ICRP methyl mercury is considered to be totally absorbed from the GI-tract, i.e., $f_1=1$. Retention of the systemic burden is assumed to be described as

$$R(t) = 0.95e^{\frac{-\ln(2)t}{80}} + 0.05e^{\frac{-\ln(2)t}{10,000}} ,$$

where t is in days. The following relationships are suggested for specific organ/tissues:

Kidney	$R_k(t) = 0.08R(t)$
Brain	$R_B(t) = 0.20R(t)$
Other	$R_0(t) = 0.72R(t)$

Assuming an intake rate I, the total body burden q after 50 years of continuous intake is estimated as

$$q = If_1\bar{R}(50y) ,$$

where

$$\bar{R}(50y) = \int_0^{50x365} R(t)dt .$$

Evaluation of the integral yields 630d. Assuming for reference purposes an intake rate I of 1 µg/d, then q = 630 µg. This burden is distributed in the body as

ORGAN	BURDEN (µg)	ppm
Kidney	50	0.16
Brain	130	0.093
Other	450	0.0066
Total	630	

Bernard & Purdue

Bernard and Purdue have submitted a paper to Health Physics reporting metabolic models for methyl and inorganic mercury. They suggest that 90% of ingested methyl mercury is absorbed from the GI-tract and that the retention of systemic mercury can be approximated as

$$R(t) = 0.9(1 + \frac{0.35}{50}t)e^{-.7t/50} + 0.05e^{-.7t/10,000} + 0.05e^{-.7t/.25}.$$

The following organs/tissues distribution are indicated under their model:

Kidney	$R_k(t) = 0.50R(t)$
CNS (brain)	$R_e(t) = 0.20R(t)$
Blood	$R_b(t) = 0.09e^{-0.7t/50} + 0.91e^{-0.7t/.25}$.

Evaluation of $\int R(t)dt$ yields 610 d over the 50 y period, in excellent agreement with the ICRP 30 model. Bernard and Purdue suggest f_1 be taken as 0.9 for methyl mercury. Assuming an intake rate of 1µg/d with their model the following organ/tissue burdens are estimated;

ORGAN	BURDEN (µg)	ppm
Kidney	270	0.87
Brain	110	0.079
Other	170	0.0025
Total	550	

The Bernard and Purdue model addresses urine and fecal excretion, a topic not addressed in the ICRP 30 model. At equilibrium for the 1 µg/d intake, fecal excretion would be about 0.4 µg/d with the remainder in urine. These data are in general agreement with the Reference Man data.

Discussion

The mercury metabolic models of Publication 30 and Bernard and Purdue indicate similar systemic burdens (630 and 550 µg per µg/d intake). This is probably a consequence of both modeling attempts seeking to preserve the mercury balance data of Reference Man. The models, however, differ significantly in their distribution of the burden within the body, particularly with respect to the kidney. The values for the brain, probably of more significance than the kidney, are comparable for the two models.

Application of Metabolic Models to Mercury Report

The best estimate of mercury concentration in beef and milk are given in the report as 1.57 and 0.0028 μg/g, respectively. Using per capita consumption rates (90.4 and 252 g/d for beef and milk, respectively) a daily intake of 142 μg is indicated. This projected intake is about an order of magnitude higher than the Reference Man data and a factor of four higher than the FDA 30 μg/d maximum tolerable intake derived for setting a standard for Hg in aquatic organisms. Assuming this intake rate, the systemic burden of mercury indicated by the models would be about 85 mg, with blood levels of 0.009 ppm or about 460 times higher than the 20 ppb tolerance level of FDA. At this time we have not reviewed in detail the metabolic model used by FDA and only note that the relationship between blood levels and systemic burdens between various models seems to vary significantly. Continued effort in the environmental and metabolic modeling is indicated particularly the biotransformation rate between methyl and elemental forms.

Conclusion

As indicated in the draft report, the environmental levels of Hg are high enough to present a potential health hazard if the postulated intakes by man were a reality. The draft report is acceptable as written.

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

March 1, 1983

To: George Kamp

From: Jeff Giddings JMG

Subject: Y-12 biological monitoring program for New Hope Pond

I found our meetings yesterday and last week very useful as an orientation to the issues relating to water quality protection at Y-12. Clearly, there are no easy answers in a situation complicated by conflicting interests and pressures from so many sources--the state, EPA, DOE, Union Carbide, the public and the press--but the discussions left me with the encouraging impression that you and your colleagues are sincere in your objective of preventing environmental damage from the plant effluent. I sympathize with your frustration in having to anticipate and satisfy requirements and regulations that aren't yet clearly defined. Under these circumstances, it seems to me, the safest course in the long run is to stick with sound scientific principles: when the confusion subsides, you'll be left with data that mean something.

In thinking about the meeting afterwards, it seemed that I should clarify a few points. Keep in mind that my expertise is in aquatic toxicology and not environmental law; I've had little direct experience with permits, regulations, or water quality boards.

(1) There are indeed many standardized, widely-accepted methods for measuring effects of toxicants on aquatic organisms. They are included in Standard Methods because they are standard methods. Industries and environmental research organizations conduct thousands of bioassays every year using Daphnia, bluegill, fathead minnow, rainbow trout, green algae and other species. The results are used for a variety of purposes, including compliance with regulations. The fact that EPA and the state don't require specific bioassays doesn't mean that they don't accept or require bioassay results, merely that they let the permit applicant decide which tests to use. If the test is done according to basic toxicological procedures, the results are likely to be accepted--although the weight that they are given will depend on their relevance to the situation. A bioassay on your effluent using lobsters wouldn't help you much; but a bioassay with any one of a dozen well-known freshwater test species would be extremely useful as an indicator of potential hazard to the kinds of organisms that might inhabit East Fork Poplar Creek. Daphnia magna and fathead minnows are ecological

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"white rats". They are used in bioassays because (a) they have characteristics that make them convenient experimental subjects for such purposes, and (b) even though they aren't ecologically or economically important species, their responses to toxicants are indicative of the responses of other species. A competent toxicologist or environmental administrator interprets bioassay results with these things in mind.

(2) Biological tests don't substitute for chemical analyses, but rather complement them. You can't analyze for everything, particularly organics. Even if you had a complete list of everything in the water, including its chemical form (which can drastically affect biological activity), you couldn't say whether or not it was hazardous without data on the toxicity of every constituent, both singly and in combination. In short, the only way to be certain that an effluent is or is not toxic is to measure its toxicity directly.

(3) You can address the issue of New Hope Pond in two ways--by measuring ~~the inherent~~ toxicity of the outfall, or by measuring ecological effects in Poplar Creek. The former is infinitely easier than the latter; it isn't complicated by other sources of disturbance to the Creek; it is more precise and less ambiguous and therefore more readily interpreted. This is all largely a matter of appropriate reference points ("controls"): in a bioassay, you measure the performance of an organism in the test water and compare it with an organism in water of known quality; in an impact study, you measure the ecological characteristics of the creek and compare it with--what? In this case, we can't compare with upstream; we can't compare with pre-operational conditions; we don't even have an obviously unimpacted stream for reference. A survey of East Fork Poplar Creek might prove that it isn't an "aquatic desert" but wouldn't prove that Y-12 effluent isn't causing an impact.

Hopefully, the state will clarify its intentions and give you some indication of what sort of data they'd like to see. They may not. If you have a genuine problem--i.e., if the outfall of New Hope Pond is indeed toxic--then short-term public relations measures won't help you in the long run. And the sooner you evaluate the situation the better off you'll be. Not to do anything because you're afraid of what you might find out would be your worst course--you don't want the Appalachian Observer to learn something before you do. Regardless of what the state decides to do this month or this year, it is in your best interest (in my opinion) to begin biological monitoring now. You may have to tailor the monitoring plan as the situation changes or new issues arise, but that won't invalidate what you do right now. In the absence of guidance from the permittors, take the samples and run the tests that you think are appropriate. Even a single acute survival test on a single grab sample from the outfall would be better than nothing at all, which is what you have now--and you can actually do much better than that, in a short time, for relatively little money.

I hope you don't mind my voicing an opinion. The decision is yours, of course, and we'll be ready to help when you're ready to go.

Jeff

cc: Julie Dorsey
Carl Gehrs
S. I. Auerbach
Lynn Peacock
Todd Butz
W. Van Winkle

HSEA83J-0303-40

NUCLEAR DIVISION

INTERNAL CORRESPONDENCE

March 3, 1983

Distribution

Summary, Bioassay Discussions to Date

Two meetings were held and a third one is scheduled 1:30 p.m. March 7 in the 9711-1 conference room to determine what information we are looking for from bioassay testing of the effluents from New Hope Pond and Bear Creek and what we would do with the information gained. Preliminary discussions about these tests have been held with ORNL Aquatic Sciences and Battelle Columbus.

Jeff Giddings of ORNL discussed the nature of two types of bioassay tests. Acute tests are used to evaluate toxicity and are typically run for about 48 hours. Chronic tests are more sensitive than acute tests and are typically run for at least one or more life cycles of a species. Fathead minnows and Daphnia Magna are common species used. Daphnia tests are more sensitive than fish tests. The chronic Daphnia test runs about 21 days covering 3 life cycles.

Dr. Rafael Bustemante was asked if the State requires, uses, or is considering using bioassay tests for water quality decision making; and if so, what type of bioassay testing would be required. He agreed to find out more about this and discuss this at the March 7 meeting.

In addition to the type of test(s) we may perform, other questions raised at the meeting include:

1. What species are we trying to protect in the streams?

2. Should we put some type of fish cages in the effluents? If so, what are the front end and operational costs and problems?

3. Will bioassay or living fish data be useful in negotiations with the State and EPA, or will this only be of value for public relations?

4. If we are not likely to be required to perform these tests by a government agency, should we do them at all?

5. What will we do if the results are unfavorable?

The March 7 meeting will provide the opportunity for clarification of the State's position, as well as opportunity for further discussion of the questions raised. Dr. Bustemante will be at this meeting to discuss the State's position.

GK

George Kamp, 9106, MS-5 (6-5971)

Distribution:

T. R. Butz, 9106, MS-5	P. M. Pritz, 9106, MS-5
J. G. Dorsey, 9995, MS-2	M. Sanders, 9106, MS-5
J. M. Giddings, 1515, 230, ORNL	H. H. Stoner, 9106, MS-5
J. M. Napier, 9202, MS-1	R. R. Turner, 1505, 214, ORNL
L. J. Peacock, 9106, MS-5	J. C. White, 9704-2, MS-19

APPENDIX 12

LITERATURE SURVEY OF POPULATION DENSITY DATA FOR SELECTED SPECIES OF SPORT FISH IN STREAMS, RESERVOIRS, AND LAKES

(From S. I. Auerbach to L. J. Peacock, dated November 9, 1982)

NUCLEAR DIVISION

INTERNAL CORRESPONDENCE

November 9, 1982

Lynn J. Peacock, 9106, MS-5, Y-12

Literature Survey of Population Density Data for Selected Species of Sport Fish in Streams, Reservoirs, and Lakes

Enclosed is a literature survey on the above topic prepared by Dr. J. W. Elwood of this division in response to a request by G. E. Kamp of your department. This information is wanted by J. F. Wing and G. J. Marciante, Division of Safety and Environmental Control, Oak Ridge Operations Office, as a supplement to our recent central files memo "Mercury Contamination in East Fork Poplar Creek and Bear Creek," by W. Van Winkle et al. (ORNL/CF-82/267, September 1982). This literature survey will also be included as part of a second central files memo presently being prepared.

Please do not hesitate to contact us if you need further assistance.

S. I. Auerbach, 1505, X-10 (4-7301)

SIA:WVW:nsh

Enclosure

cc: J. W. Elwood, 1505, X-10
G. E. Kamp, 9106, MS-5, Y-12
C. R. Richmond, 4500-N, Room I-206, X-10
H. H. Stoner, 9704-2, MS-11, Y-12
W. Van Winkle, 1505, X-10 (RC)

Literature Survey of Population Data for Selected Species of Sport Fish in Streams, Reservoirs, and Lakes.

Jerry W. Elwood
Environmental Sciences Division
Oak Ridge National Laboratory

November 1982

The attached tables contain the results of a literature survey requested by Gabe Marciante, DOE-ORO Division of Safety and Environmental Control, on populations of selected species of sport fish in streams, reservoirs, and lakes. Data were compiled for bluegill (Lepomis macrochirus), rock bass (Ambloplites rupestris), green sunfish (Lepomis cyanellus), and largemouth bass (Micropterus salmoides). These four species of sport fish are known to be present in the East Fork of Poplar Creek (EFPC), and thus, each represents a potential source of mercury contamination to humans utilizing sport fish from this mercury-contaminated stream. Population data for these four species in reservoirs and lakes are included because the lower section of EFPC is inundated by Watts Bar Reservoir, and thus, in terms of habitat, is no longer a stream. I did not locate any references containing population data for any of the four fish species in Tennessee streams.

With one exception, the density values presented in the attached tables are for all sizes of fish (i.e., immature and adult fish). Thus, they are probably overestimates of the density of catchable (by sport fishermen) fish of each species because the estimates include smaller fish that sport fishermen could not catch using standard sport fishing methods (hook-and-line).

A question was raised by Gabe Marciante concerning the number of sport fish in the upper section of EFPC where, in May 1982, the average total mercury concentration in axial muscle of bluegill weighing $\geq$ 63 g exceeded the FDA "action level" for mercury of 1.0 ppm (see Figure 4, pg. 34 in ORNL/CF-82/267 by Van Winkle et al.).

The average width of EFPC in this upper section (i.e., from New Hope Pond approximately 16.1 km downstream) is approximately 3.5 m [Dahlman, R. C., J. T. Kitchings, and J. W. Elwood (eds.), 1977, Land and water resources for environmental research on the Oak Ridge Reservation, ORNL/TM-5352, 79 pp.]. Thus, there is approximately 5.6 ha of stream surface area in the upper portion of EFPC where the mercury contamination in sport fish is most severe.

Table 1. Densities and standing stock biomass of bluegill, green sunfish, and rock bass in streams

Stream	Species	Density (number/ha)	Standing stock biomass (kg fresh weight/ha)	Reference
White River, Ind.	Bluegill	1351[a] (1969)	73.7[a] (1969)	1
" " "	"	1467[a] (1970)	79.9[a] (1970)	1
" " "	"	698[b] (1969)	42.1[b] (1969)	1
" " "	"	260[b] (1970)	15.6[b] (1970)	1
Otter Cr., Ind.	Bluegill	11, range 4-47 (summer)	-	2
" " "	"	28, range 0-91 (fall)	-	2
" " "	Green sunfish	5, range 0-72 (fall)	-	2
Mill R., Mich.	Bluegill	-	49	3
Clemson Fork, Kent.	Rock bass	170 (1967)	2.1	4
" " "	" "	170 (1968)	2.8	4
Steeles Run, Kent.	Bluegill	-	3-34 (2nd-order)	5
" " "	"	-	3 (3rd-order)	5
" " "	Green sunfish	-	3-4 (2nd-order)	5
" " "	" "	-	1-14 (3rd-order)	5

[a]Control section.

[b]Thermally altered section.

<u>References and Site Descriptions</u>

1. Benda, R. S. and M. A. Proffitt. 1974. Effects of thermal effluents and invertebrates, p. 438-477. In: J. W. Gibbons and R. R. Sharitz (eds.) Thermal Ecology. AEC Symposium Series (CONF. 730505).

White River, Indiana - average width = 137 m; depth = 1.2-4.3 m; average discharge of 2500 cfs; turbid water; silt-sand-mud bottom. The White River receives a thermal effluent from a coal-fired power plant. No indication of other sources of pollution in this stream.

2. Grossman, G. D., P. B. Moyle, and J. O. Whitaker, Jr. 1982. Stochasticity in structural and functional characteristics of an Indiana stream fish assemblage: A test of community theory. <u>Am. Nat. 120</u>: 423-454.

Otter Creek, Indiana - clean, shallow stream with rock-gravel-sand bottom, study site below dam in riffle-pool section. The fish community is dominated by darters and minnows; none of the 10 most abundant fish species were sport fish. Bluegill accounted for approximately 1% of the fish collected in summer and fall; green sunfish accounted for <1% of the fish collected. No indication of pollution in this stream.

3. Carlander, K. D. 1977. <u>Handbook of Freshwater Fishery Biology</u>, Volume 2. Iowa State University Press, Ames, Iowa.

Mill River, Michigan - no information immediately available on this stream.

4. Lotrich, V. A. 1973. Growth, production, and community composition of fishes inhabiting a first-, second-, and third-order stream of eastern Kentucky. <u>Ecol. Monogr. 43</u>: 377-397.

Clemson Fork, Kentucky - average width = 1.9 m; depth = 30 cm; stream receives some acid mine drainage from strip mining in the watershed; rock-gravel-silt bottom.

5. Small, J. W., Jr. 1975. Energy dynamics of benthic fishes in a small Kentucky stream. <u>Ecology 56</u>: 827-840.

Steeles Run, Kentucky - spring-fed stream in central Kentucky; second-order section is 4-5 m wide; fine clay-medium stone substrate; shallow pools and short riffle; average temperature in June-September period is 16-21°C. Third-order section is 5 to 7.5 m wide, substrate similar to that of second-order section, average temperature during June-September period was 19-25°C.

Table 2. Bluegill and largemouth bass density in ponds, lakes, and reservoirs

Site	Species	Density (number/ha)	Standing stock (kg freshwt/ha)	Reference
Wyland Lake, Ind.	Bluegill	-	72	1
Michigan ponds	"	-	$\overline{X}$ = 344, range = 83-480	1
Mill Lake, Mich.	"	-	49	1
Williamson Pond, Iowa	"	-	221	1
Illinois ponds	"	-	range = 112-194	1
Kentucky ponds	"	-	range = 353-744	1
Texas reservoirs	"	-	range = 35-2284	1
Oklahoma pond	"	-	8.4	1
Lakes and reservoirs	"	-	$\overline{X}$ = 50-60	2
Douglas Lake, Tenn.	"	227	4.4	3
Tennessee reservoir	Largemouth Bass	-	3.8	1
North American lakes and reservoirs	" "	-	$\overline{X}$ = 16.8	1
Lake Lanier, Ga.	" "	-	4.9-12.6	1
34 Texas reservoirs	" "	-	$\overline{X}$ = 21.5, range 0.1-66.1	1
Bull Shoals, Ark.	" "	20.7-115 (bass >23 cm)	-	1
Douglas Lake, Tenn.	" "	26	15.5	3

References

1. Carlander, K. D. 1977. Handbook of Freshwater Fishery Biology, Volume 2. Iowa State University Press, Ames, Iowa.

2. Bennett, G. W. 1962. Management of Artificial Lakes and Ponds. Reinhold Publ. Corp., New York, N.Y.

3. Hayne, D. W., G. E. Hill, and H. M. Nichols. 1967. An evaluation of core sampling of fish populations in Douglas Reservoir, Tennessee, p. 244-297. In: Reservoir Fishery Resources Symposium. American Fisheries Society, Washington, D.C.